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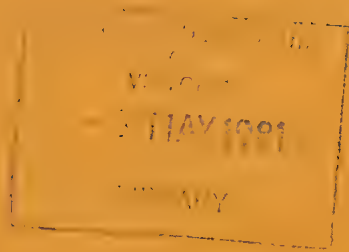
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THE HISTORY OF THE

REPUBLIC OF THE UNITED STATES OF AMERICA

THE HISTORY OF THE
REPUBLIC OF THE UNITED STATES OF AMERICA
FROM THE FIRST SETTLEMENTS TO THE PRESENT
BY
JAMES M. SMITH
VOLUME I
THE FOUNDING OF THE NATION
FROM 1492 TO 1789
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JOURNAL of the
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Benth., *Fl. Austral.* 4: (1868) 111.

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10-30 specimens should be cited for each species (or subspecific taxon), although this may be varied under certain circumstances. The author may decide whether or not to include dates of collections and the sequence, provided a constant pattern is adhered to throughout a paper.

Authors wishing to cite all specimens seen may list them all in an index to collectors after the style of the "Flora Malesiana" identification lists. Collections not identifiable by a collection number (assigned by either the collector or herbarium) should cite dates.

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A TAXONOMIC REVISION OF *NICOTIANA* (SOLANACEAE) IN AUSTRALIA

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Abstract

A taxonomic account of *Nicotiana* in Australia is presented, together with a key to the species and subspecies, and distribution maps. 16 endemic and 1 introduced species are recognized. Two new subspecies are described: *N. debneyi* subsp. *monoschizocarpa* and *N. megalosiphon* subsp. *sessilifolia*. Two new combinations are effected: *N. occidentalis* subsp. *hesperis* (formerly *N. hesperis*) and *N. rosulata* subsp. *ingulba* (formerly *N. ingulba*). *N. exigua* is treated as a probable synonym of *N. suaveolens*.

Introduction

Nicotiana comprises about 63 species which range from small annuals to woody, sub-arborescent shrubs. They are distributed in North and South America (15 and 36 species respectively, 45 in all, Goodspeed, 1954), south-western Africa (one species, Merxmüller & Buttler, 1975), some southern Pacific islands (one species) and in Australia where 17 species occur in areas collectively covering most of the continent. One of these 17, *N. debneyi*, also occurs on Lord Howe Island and in New Caledonia, and another, *N. glauca*, is introduced. No species occur in Tasmania.

The most recent world-wide account of *Nicotiana* is the comprehensive monograph of Goodspeed (1954), in which the taxonomic treatment of Australian species is largely based on the work of Wheeler (1935) who recognized 14 Australian species of which 6 were new. Goodspeed placed the Australian species, together with one species (*N. fragrans*) from southern Pacific islands, in the section *Suaveolentes* of the subgenus *Petunioides*. The section is distinguished by the lowest anther being on the longest filament (although not always so in *N. debneyi*) (Goodspeed, 1945, 1954). A revision of the Australian species of the genus was published by Burbidge (1960), which included descriptions of 5 new species and 2 new subspecies. Since Burbidge's revision, many more field collections of Australian *Nicotiana* have been made which in some cases have greatly extended the previous known ranges of their respective species, and which have further illuminated their taxonomic relationship.

This account is presented as one of a series of revisions of genera of the Solanaceae in Australia conducted at the Herbarium of the Waite Institute. Some observations of field specimens were made and several species grown in cultivation, but the study is based primarily on dried herbarium material from the following herbaria: AD, ADW, BRI, CANB, MEL, NSW, NT, PERTH, SYD and the private herbarium of Mr A. C. Beauglehole. Abbreviations for herbaria are those given by Holmgren & Keuken (1974). All specimens seen have been annotated, and all specimens cited have been seen unless otherwise stated.

General notes on morphology

The morphology of Australian *Nicotiana* may vary considerably according to different environmental conditions. Individuals growing under harsh conditions may be stunted with small, narrow leaves and almost leafless stems, but others of the same species growing in wetter and more fertile soil may attain more than thrice the height with leafy stems and large, lush, broad leaves. The calyx, capsule and particularly the corolla may

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likewise vary in overall and relative dimensions, according to the stage of maturity of the plant as well as to environmental factors. Thus the corolla tubes of flowers on older plants are shorter and narrower than usual.

Indumentum

The epidermal vestiture, where present, consists of unbranched multicellular, eglandular or glandular trichomes; hydathodes are usually also present. Burbidge (1960) reported the occurrence of branched hairs in *N. rotundifolia*; I did not find any in the specimens of this or any other species which I examined. The glandular trichomes are of two kinds, one terminating in a single globular cell ("globular-headed") and the other in an ellipsoid-shaped head of several cells ("ellipsoid-headed"). The former render the living plant clammy to the touch, and plants with the latter are distinctly viscid, frequently with seeds, dirt and other fragments adhering to them. These trichome types are illustrated in Fig. 1. The degree of pubescence may vary considerably within the one species or subspecies. For instance, in a normally densely pubescent species, occasional specimens may occur with glabrescent stems. Additionally, older growth is usually more sparsely pubescent than more recent growth, and over-mature plants are always comparatively more sparsely pubescent.

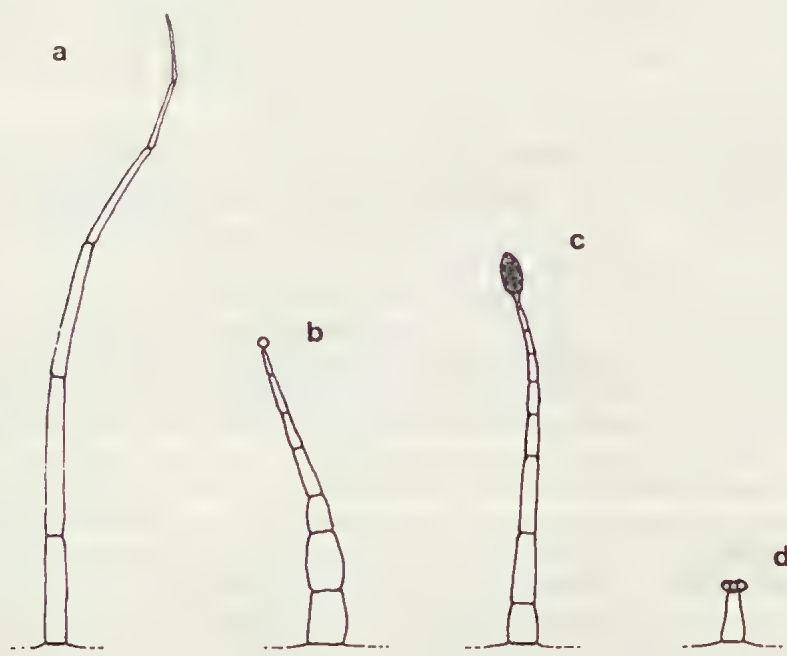


Fig. 1. Trichomes of Australian *Nicotiana*. (a) eglandular; (b) glandular, globular-headed; (c) glandular, ellipsoid-headed; (d) hydathode.

Leaves

The petiole in all Australian *Nicotiana* is winged to a greater or lesser extent, the wing being continuous with the leaf lamina. Thus the petiole is not abruptly distinct from the leaf blade, except for instance in the leaves of *N. cavicola* and *N. umbratica*, the bases of which are mostly cordate. For convenience, the demarcation between petiole and lamina is here taken to be the point at which the leaf margin becomes concave, proximal to the widest part of the leaf.

Pedicels

The pedicels of *Nicotiana* elongate continuously from bud initiation to maturation of the fruit. At anthesis the pedicel is about 1-3 mm long, but in the mature, dry fruit it may vary in length from 15-46 mm, depending upon the species. This latter measurement is therefore stated in the species descriptions.

Corolla

Goodspeed (1954) distinguished the parts of the corolla of *Nicotiana* as follows: "tube proper", "throat cylinder" and "throat cup", all forming the "tubular part", and the "limb". For convenience, this terminology is followed here, except that the "tubular part" is referred to simply as the "tube" (Fig. 2). In most Australian *Nicotiana* the throat cup is hardly distinct from the throat cylinder, and in many the throat cylinder merges directly into the tube proper (that part of the tube below the insertion of the lowest stamen) and cannot be distinguished from it. The corolla lobes are the 5 segments comprising the limb, and their extent of fusion varies from proximally only to almost completely. Their margins may be acute, obtuse, or emarginate.

Cleistogamy

In all species there is at least some incidence of cleistogamy. The corolla in cleistogamous flowers is shorter and proportionately narrower than in chasmogamous flowers and often scarcely exceeds the calyx and may even be shorter than it. The corolla limb remains closed at all times. Cleistogamy in *Nicotiana* can frequently be observed in older plants. It may apparently be induced by short-day conditions (Burbidge, 1960), and might also be influenced by temperature since a specimen of *N. occidentalis* subsp. *obliqua* producing cleistogamous flowers in cultivation at the Waite Institute formed chasmogamous flowers when moved to a warmer glasshouse.

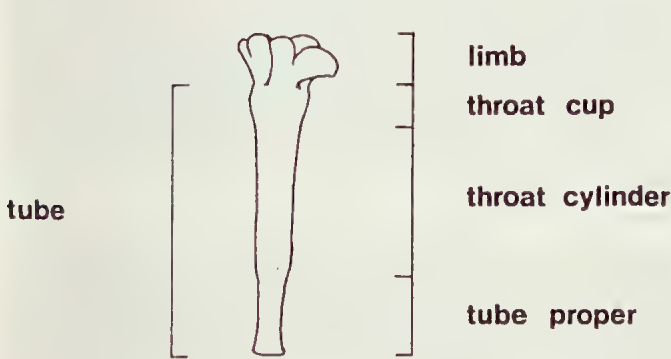


Fig. 2. Terminology of corolla parts.



Fig. 3. Seeds of *Nicotiana occidentalis* subsp. *hesperis*. Upper: not crested; voucher N.T. Burbidge 6485 (CANB). Lower: crested; voucher N.T. Burbidge 6461 (CANB).

Capsules

In all but *N. debneyi* subsp. *monoschizocarpa*, the capsules of Australian *Nicotiana* dehisce along two perpendicular planes. The major dehiscence is partly septicidal and partly septifragal and separates the two valves to near the base. Part of the inner septa remain adherant to each other, together with the placentae, and part splits away leaving a margin along the valves near their base. The secondary dehiscence (which does not take place in *N. debneyi* subsp. *monoschizocarpa*) is loculicidal and splits each major valve in two, for up to about half their length from the apex. The apices of each of the now 4 valves then recurve outwards as the capsule dries.

Seeds

Burbidge (1960) first brought to attention the diagnostic value of seeds of Australian *Nicotiana*. The testa is highly ornamented with sharp or rounded ridges forming honeycombs or wrinkles, and the seed shape varies from oblong, i.e. straight, to tightly curved and C-shaped. A dorsal crest may also sometimes occur on the seeds of *N. occidentalis* subsp. *hesperis* (Fig. 3). Generally only a little variation in seed shape and ornamentation occurs within one species or subspecies, so these are fairly reliable characters for distinguishing between many taxa. Care must be taken with dried herbarium specimens, however, to ensure that the seeds examined are fully mature, otherwise the testa is shrunken and shrivelled to a greater or lesser extent, thus obscuring the seed shape and ornamentation. It is therefore recommended for all future collections of *Nicotiana* that, if possible, mature seeds be collected and placed in a packet with the specimen. Photographs of seeds of all species and subspecies are given by Burbidge (1960), and a few are illustrated here (Fig. 4) to show the range of shape and ornamentation which occurs.

Hybrids

A number of possible hybrids between species of *Nicotiana* were noted. Their morphology was studied in detail and compared with that of the putative parent species. Pollen from several of these specimens was stained with lactophenol aniline blue to estimate pollen fertility and thus possibly to determine further evidence of hybridization. The several apparent hybrids, between Australian *Nicotiana* species and the introduced *N. glauca* are noteworthy in that they are between species from different continents and of different sections of the genus. Hybridization amongst Australian *Nicotiana* species in the field appears to be limited; few collections were seen which, judging by their morphology, might represent such hybrids.

(1) *N. glauca* x *N. suaveolens*

A specimen almost certainly of this hybrid is: *P.R.H. St John s.n.*, south side of Station Peak, You Yangs, Vic., 25.ix.1930 (MEL s.n.). The calyx and corolla of this specimen are intermediate between those of the two parent species, and the leaves have the shape of *N. suaveolens* leaves but the terete petiole of *N. glauca*. No fruits are present on this specimen, and it was annotated by H.-M. Wheeler in May 1934: "Pollen from mounted hybrid flower consists largely of shrunken grains".

This hybrid, from a population in the same area (where both parent species were also growing at the time), was later described by Nicholls (1936) as a distinct species: *N. flindersiensis* (see below). Unlike the St John collection, the hybrids Nicholls found were apparently setting capsules; he made no mention of seeds, however. There is no evidence that a stable population of this hybrid has been maintained and therefore no reason to retain *N. flindersiensis* as a distinct taxon.

N. flindersiensis Nicholls, Vict. Nat. 53:64, pl. VII (1936).

Holotype: *W.H. Nicholls s.n.*, Flinders Peak, You Yangs Range, Vic., date? (MELU, n.v.).

(2) *N. glauca* x *N. simulans*

A possible hybrid between these two species is represented by the following specimen: *E.H. Ising s.n.*, Fish Hole, 32km south of Oodnadatta, S.Aust., 25.viii.1955 (AD97413287). It was collected together with *N. simulans* and, although no collections of *N. glauca* from that area have been noted, it is possible that it also occurs or once occurred there. The specimens bear glabrous stems and leaves, the latter (mostly radical) the shape of *N. simulans* leaves but with almost terete petioles. The calyx and corolla are similar to those of *N. glauca* but smaller, and the staminal arrangement is similar to that of *N. simulans*, with 4 anthers on short filaments and one on a long filament. The pollen is about 94% fertile, and capsules and seeds were formed. The seeds are intermediate in shape and ornamentation between *N. glauca* and *N. simulans*.

(3) *N. glauca* x *N. goodspeedii*

Almost certainly a hybrid between these two species is: *R.D. Pearce 144*, 17.6km from Blanchetown on Morgan Road, 15.x.1978 (ADW). The glabrous stems are somewhat leafy below the inflorescence, and the leaves, also glabrous, are intermediate in morphology between the two parent species. The calyx and corolla are also intermediate, but the filaments are all long as in *N. glauca*. The pollen is only about 5% fertile and no capsules were set.

(4) *N. maritima* x *N. suaveolens*

A reputed amphiploid strain of such a hybrid was given specific status (*N. eastii*, see below) by Kostoff (1939). The strain was grown by Kostoff from seeds received in 1936 and collected by R.G. May from Bathurst, N.S.W. However, Goodspeed (1954) believed that Kostoff's evidence for the origin of this species was inconclusive and insufficient, and that the strain was probably a tetraploid *N. suaveolens*. Furthermore, *N. maritima* is not known to occur anywhere near Bathurst, so the possibility of its being one parent of such a hybrid is extremely remote.

N. eastii Kostoff, Curr. Sci. 8:110(1939), nom.nud.

(5) *N. aff. benthamiana* x *N. velutina*

A collection: *D.E. Symon 9306*, Dalhousie Springs, S.Aust., 24.ix.1974 (ADW), appears to represent hybridization between *N. velutina* and a population of anomalous *Nicotiana* resembling *N. benthamiana* (see notes under *N. benthamiana*). Both presumed parents were also growing in the vicinity of the hybrid at that time (D.E. Symon, pers. comm. 1978). The habit and sessile nature of the leaves of this plant are like *N. benthamiana*, but the leaves are narrower, more like those of *N. velutina*, and the flowering stems are leafless with racemose or paniculate inflorescences as in *N. velutina*. The flowers are similar to those of *N. velutina* although the corolla is somewhat larger than average. The pollen is only about 4% fertile and no fruits were formed.

(6) ? *N. suaveolens* x *N. velutina*

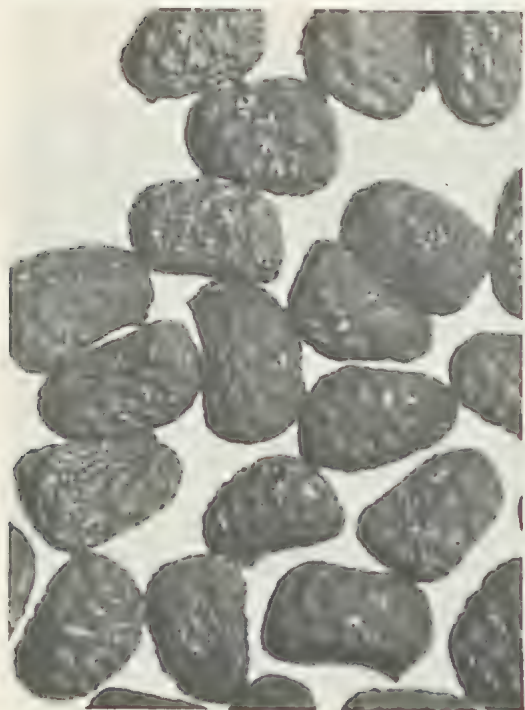
A group of specimens from north-eastern New South Wales closely resembles



a



b



c



d

Fig. 4



e



f



g

Fig. 4 (cont.)

Fig. 4. Seeds of Australian *Nicotiana*. (a) *N. megalosiphon* subsp. *megalosiphon* X30, voucher T.J. McDonald 72 (BRI); (b) *N. megalosiphon* subsp. *sessilifolia* X30, voucher P.K. Latz 1695 (ADW); (c) *N. debneyi* subsp. *debneyi* X30, voucher P. Horton s.n. (ADW 54319, cultiv. from seeds of A.G. Floyd s.n., 12.iii.1979); (d) *N. debneyi* subsp. *monoschizocarpa* X30, voucher P. Horton s.n. (ADW 54171, cultiv. from seeds of C.R. Dunlop 5028); (e) *N. velutina* X30, voucher P. Horton 191; (f) *N. maritima* X30, voucher P. Horton s.n. (ADW 51395, cultiv. from seeds of D.E. Symon 10563); (g) *N. benthamiana* X30, voucher P. Horton s.n. (ADW 51287, cultiv. from seeds of P.K. Latz 6524).

N. suaveolens with the exception of their seeds, which are mostly C-shaped and approach those of *N. velutina*. These collections are from an area marginal between the distributions of *N. suaveolens* and *N. velutina*, and so might represent some introgression between these two species (which share the chromosome number $n=16$). The pollen of one specimen, *W.K. Anderson s.n.*, was tested for viability and found to be about 97% fertile.

The specimens are held at NSW and are:

W.K. Anderson s.n., Narrabri Agricultural Research Station, 31.i.1968 (NSW 128042); *C.W. Antaw s.n.*, Coonabarabran district, 26.vi.1953 (NSW 24229); *G.A. Borthistle s.n.*, Gunnedah, March 1919 (NSW 48806); *B.G. Briggs 2284*, Mt Nombi, 29.ix.1968; *H.L. Jones s.n.*, Coonamble, 25.i.1911 (NSW 48821); *Narr s.n.*, Gunnedah, 7.iii.1941 (NSW 48775); *R. Slack-Smith s.n.*, Coonamble, 12.iv.1977 (NSW 141412); *Anon. (Shire Clerk) s.n.*, Gilgandra, May 1936 (NSW 48767).

(7) ? *N. megalosiphon* x *N. velutina*

A few specimens from mid and southern Queensland appear to be robust individuals of *N. velutina* with the exception of the corolla which is about 35-40 mm long. These collections are from an area in which both *N. megalosiphon* and *N. velutina* occur, and so might represent hybridization between these two species. The pollen from one specimen, *S.T. Blake 12104*, was tested for viability and found to be about 92% fertile.

The specimens are held at BRI and are:

S.T. Blake 10336, Geera, 30.xi.1935; *12104*, Windorah, 13.vii.1936; *S.L. Everist 7442*, Ingella, 3.viii.1963; *K.J. McFarlane s.n.*, Charleville, 14.viii.1960 (BRI 25476); *M.D. Power s.n.*, Blackall, 11.iv.1961 & June 1961 (BRI 28014 & 27694).

Ecology

The Australian species of *Nicotiana* are all annuals or short-lived perennials. Most can be found in specific habitats such as deep sands or rocky outcrops, and frequently in the shelter of boulders, under rocky overhangs, or in cave entrances. In general they grow in disturbed or open sites with little or no competition from other plant species, and may often be found in abundance following bushfires or heavy rains after drought. All species contain one or more pyridine alkaloids (Willaman, 1961, McBarron, 1976) and have occasionally been suspected of poisoning stock if consumed in large quantities.

Uses

Several species of Australian *Nicotiana* were highly prized by aborigines for use as a chewing tobacco, and were traded widely (for a recent summary of aboriginal use of Australian *Nicotiana*, see Peterson, 1979). The native tobaccos were not smoked but chewed, the leaves being crushed (either fresh or more usually having first been dried) and mixed with wood ash, then rolled into a quid.

NICOTIANA L.

L., Sp. Pl. 1:180 (1753); Gen. Pl. 84 (1754).

Type species: N. tabacum L., Sp. Pl. 1:180 (1753), lectotype, vide Britton & Brown, Ill. Fl. N.U.S. ed. 2, 3:170 (1913).

Annual or short-lived perennial herbs, often malodorous, with 1 to several erect or ascending stems occasionally woody at the base, (or a spindly perennial shrub with one or a few main woody stems). *Indumentum* varied, stems and leaves glabrous to pubescent with simple, multicellular, eglandular or glandular trichomes, often eglandular on proximal parts and becoming glandular more distally along stem, often with inflated cells; young growth, leaf veins and often margins more densely pubescent than other

parts; pedicels and calyx sparsely to densely pubescent with simple, multicellular, eglandular or usually glandular trichomes, many with inflated cells; corolla pubescent outside with short, usually eglandular trichomes, and glabrous inside except for eglandular trichomes near base of tube. *Leaves* alternate, exstipulate, petiolate or lower leaves petiolate to sub-petiolate and upper leaves sessile; usually numerous radical leaves in basal rosette merging into few or numerous cauline leaves, or leaves mostly cauline; *cauline leaves* becoming shorter and proportionately narrower more distally along stem and often merging into bracts of inflorescence; *lamina* simple, entire or with sinuate margins, occasionally undulate; *petiole* very narrowly to broadly winged, the wing continuous with lamina, (or petiole terete), becoming shorter in proportion to leaf length the more distal the leaf.

Inflorescence usually a loose, elongate panicle, rarely racemose, (or a short, dense panicle), the flowers subtended by bracts, or flowering stems leafy, the flowers solitary and subtended by leaves; flowers pedicellate; *bracts* lanceolate to linear, or occasionally leafy at base of inflorescence but always becoming smaller and narrower distally; *pedicels* erect or cernuous, lengthening in fruit. *Calyx* regular or slightly irregular, tubular or narrowly campanulate, shorter than corolla, usually enlarging slightly in fruit; *sepals* 5, fused basally to almost entirely, usually slightly unequal, often slightly conduplicate but flattening out in fruit. *Corolla* regular or slightly irregular, salverform, white and often tinged creamy-green or purplish on the outside, (or yellowish), often sweetly-scented; *tube* differentiated into throat cup + throat cylinder + tube proper, or little differentiated; *throat cup* often asymmetrically swollen; *limb* 5-lobed, contorted-plicate in bud and spreading at anthesis, thereafter loosely folding in light and expanding in shade or darkness, (or remaining open in sunlight). *Stamens* 4+1, included or rarely slightly exerted, the 4 upper ones at mouth of or in throat cup and often subdidynamous or didynamous, the lower one below the throat cup, (or all 5 in throat cup); *anthers* 2-celled, elliptic, dorsifixed, longitudinally dehiscent; *filaments* filiform, inserted on corolla tube, those of the upper 4 stamens fused to corolla for all but their distal fraction and that of the lower one fused for a considerably shorter length, or the filaments all fused to the corolla near the base only. *Ovary* superior, bilocular, *placentation* of the numerous ovules axile; *disc* short, hypogynous, annular, often orange-red; *style* terminal on ovary, filiform, extending to distal end of corolla tube; *stigma* slightly 2-lobed, discoid-capitate.

Fruit an ellipsoid or ovoid, thin-walled, 2-celled capsule, surrounded by persistent calyx, at first green, becoming brown at maturity; dehiscence septicidal-septifragal and loculicidal (i.e. splitting the capsule into 4 valves) (see Notes on morphology), or septicidal-septifragal only (i.e. splitting the capsule into 2 valves; this occurs only in *N. debneyi* subsp. *monoschizocarpa*). *Seeds* minute, numerous (95-400 per capsule), light to dark brown, almost straight, angled, reniform or tightly curved; ornamentation of testa reticulate, with or without wavy ridges, or of round-edged wrinkles.

The following infrageneric classification was proposed by Goodspeed (1945) to include all native Australian and South Pacific Island species:-

Subgenus **Petunioides** (Don) Goodspeed, Univ. Calif. Publ. Bot. 18:339 (1945).

Type species: *N. acuminata* (Graham) Hook., Bot. Mag. 56, tab. 2919 (1829).

Section **Suaveolentes** Goodspeed, Univ. Calif. Publ. Bot. 18:342 (1945).

Type species: *N. suaveolens* Lehm., Gen. Nicot. 43 (1818).

Key to Species in Australia

1. Perennial, spindly shrub to 6m high; corolla yellow 17. *N. glauca*
- Annual or short-lived perennial herb usually under 1m high;
corolla white (may be tinged purple or green on outside) 2

2. Sticky ellipsoid-headed trichomes present at least in inflorescence 3
 Sticky ellipsoid-headed trichomes absent 9
3. Laminae of lower leaves nearly as broad as or broader than long; cauline leaves petiolate 4
 Laminae of lower leaves longer than broad; at least the uppermost cauline leaves sessile or
 sessile 5
4. Petioles broadly winged; corolla lobes obtuse 2. *N. cavicola*
 Petioles very narrowly winged, almost terete; corolla lobes acute 3. *N. umbratica*
5. Inflorescence many-branched when mature (third-order branching common), leafless;
 corolla lobes obtuse to acute; seeds oblong or trapezoid 6
 Inflorescence few-branched when mature (usually second-order branching at most), often
 somewhat leafy in lower part; corolla lobes emarginate; seeds reniform to U-shaped 7
6. Corolla lobes broad, obtuse; capsule 4-valved; seed testa wrinkled 1. *N. debneyi* subsp. *debneyi*
 Corolla lobes narrow, acute to narrowly obtuse; capsule 2-valved; seed testa honeycombed
 1. *N. debneyi* subsp. *monoschizocarpa*
7. Corolla tube usually longer than 30 mm, always longer than 25 mm; upper 4 stamens
 level 4. *N. occidentalis* subsp. *occidentalis*
 Corolla tube usually shorter than 35 mm; if longer than 25 mm then upper 4 stamens
 subdidynamous 8
8. Seeds bent into a U-shape, occasionally crested 4. *N. occidentalis* subsp. *hesperis*
 Seeds reniform, never crested 4. *N. occidentalis* subsp. *obliqua*
9. Flowering stems leafy; flowers interfoliar 5. *N. benthamiana*
 Flowering stems leafless above; flowers in racemes or panicles 10
10. Cauline leaves decurrent on stem; plants (excluding flowers) glabrous 6. *N. excelsior*
 Cauline leaves not decurrent on stem; plants (excluding flowers) glabrous or pubescent 11
11. Cauline leaves (always present) broadly auriculate and stem-clasping; seed testa wrinkled 12
 Cauline leaves (if present) not auriculate or stem-clasping, or if somewhat so then seed testa
 honeycombed 13
12. Corolla tube up to 20 mm long; capsule 5-9 mm long 7. *N. amplexicaulis*
 Corolla tube at least 30 mm long; capsule 8-16 mm long 8. *N. gossei*
13. Plants entirely pubescent; corolla tube usually longer than 25 mm, with length: width usually
 exceeding 15:1 14
 Plants (excluding flowers) glabrous, or pubescent near base only, or if entirely pubescent then
 corolla tube shorter than 25 mm, with length: width usually less than 15:1 16
14. Corolla tube usually shorter than 40 mm; upper 4 stamens subdidynamous 10. *N. simulans*
 Corolla tube usually longer than 40 mm; upper 4 stamens level 15
15. Cauline leaves petiolate; seed testa wrinkled 9. *N. megalosiphon* subsp. *megalosiphon*
 Cauline leaves (at least the upper ones) sessile; seed testa honeycombed
 9. *N. megalosiphon* subsp. *sessilifolia*
16. Capsule elongate, usually about 3 times as long as broad; plants (excluding flowers) glabrous
 or sparsely pubescent near base only; corolla tube proportionately narrow (length: breadth
 more than 10:1, often more than 15:1), 1-2 mm wide; seeds not C-shaped 17
 Capsule not elongate, about twice as long as broad at most; plants glabrous or pubescent;
 corolla tube narrow to broad; seeds reniform to C-shaped 18
17. Plants (excluding flowers) glabrous or nearly so; corolla tube usually longer than 35 mm;
 cauline leaves few to several, occasionally absent 11. *N. rosulata* subsp. *ingulba*
 Plants sparsely pubescent near base; corolla tube usually shorter than 35 mm; cauline leaves
 usually absent 11. *N. rosulata* subsp. *rosulata*
18. Plants (excluding flowers) glabrous; corolla tube narrow, usually less than 3 mm wide; seeds
 C-shaped 12. *N. goodspeedii*
 Plants pubescent (stems may be glabrescent); if glabrous or nearly so then corolla tube broad
 (usually 3 mm wide or more) and seeds not C-shaped 19

19. Corolla tube usually longer than 25 mm, broadening distinctly up to limb; plants glabrous or nearly so 13. *N. suaveolens*
 Corolla tube usually shorter than 25 mm, the part distal to calyx almost constant in width; plants pubescent (stems may be glabrescent) 20
20. Seeds C-shaped; pubescence at base of plant not grey- or white-woolly 15. *N. velutina*
 Seeds reniform or angled, not C-shaped; pubescence at base of plant may be grey- or white-woolly 21
21. Pubescence usually grey- or white-woolly at base of plant; intersepal membranes not very conspicuous; corolla tube 2-5 mm wide 14. *N. maritima*
 Pubescence at base of plant not grey- or white-woolly; intersepal membranes conspicuous; corolla tube 1-2.5 mm wide 16. *N. rotundifolia*

1. *N. debneyi* Domin, Biblioth. Bot. 89:1147, pl. 36 figs. 6-8 (1929).

Type: *Dallachy s.n.*, Rockingham Bay, ?1868 (K-photo. in ADW, holo. ?; none held at PR). A collection (of 2 sheets) held at MEL bears two labels, one: "Rockingham Bay, Dall." and the other in Dallachy's writing: "Herbert River, 12 June 1868, flower white"; this may be an isotype.

Herb to 0.9 (-1.5) m high, with 1 (-3) stems which are leafy near the base. *Indumentum* on leaves and proximal portions of stems of fairly sparsely scattered eglandular trichomes; in inflorescence fairly dense and the trichomes ellipsoid-headed glandular. *Leaves* both radical and cauline, mostly petiolate but the distal ones subsessile to sessile; *lamina* (1.5-) 3-17 (-25) cm long x (0.2-) 1-13.5 cm wide, elliptic (occasionally ovate) or broadly so, to narrow-elliptic or linear at base of inflorescence; apex obtuse on basal leaves, becoming acute, to acuminate on most distal leaves; base obtuse or cuneate (and continuous with petiole) on basal leaves, to auriculate and stem-clasping on most distal leaves; margin entire to slightly sinuate; *petiole* to 9 (-14) cm long, broadly winged, somewhat stem-clasping and auriculate at the base. *Inflorescence* a loose, elongate, several-branched panicle (third- and fourth-order branching common), occupying up to $\frac{1}{2}$ (rarely more) the length of stems; *bracts* 1-10 mm long, linear to lanceolate; *pedicels* to 19 mm long in fruit. *Calyx* 4-10 mm long; sepals lanceolate to linear-lanceolate, subequal to unequal (rarely equal), fused for $\frac{1}{2}$ - $\frac{2}{3}$ their length; intersepal membranes inconspicuous. *Corolla tube* (10-) 14-20 (-23) mm long; tube proper usually distinctly narrower than throat cylinder; throat cup usually indistinct, symmetrical or slightly asymmetrical; *corolla limb* 6-13 mm diameter, closing in sunlight. Upper 4 *stamens* level or slightly subdidynamous, in throat cup (rarely the longer pair slightly exerted), fifth stamen usually between the 2 of the longer pair (occasionally between the pairs). *Capsule* (5-) 6-11 mm long, equalling or longer than calyx (occasionally slightly shorter), ellipsoid to ovoid or broadly so (length:breadth 2:1 to 3:2). *Seeds* (0.5-) 0.6-0.9 (-1.0) mm long, broadly oblong-reniform or trapezoid-reniform.

Notes

Bailey (1901) considered that a specimen collected by *G.L. Debney s.n.*, Monkira Station, Qld, Aug. 1891 (BRI 14168) was distinctive and should bear the name *N. suaveolens* var. *debneyi* (a *nomen nudum*). Domin (1929) quoted this name after describing *N. debneyi* and it seems likely that he took the varietal name and used it for his new species. The Debney specimen is in fact *N. velutina*.

In his notes to *N. debneyi*, Goodspeed (1954) considered *N. forsteri* Roem. & Schult. (based on a plant collected by Forster on the Isle of Pines) to be synonymous with *N. debneyi*. But Heine (1976) believed *N. forsteri* to be synonymous with *N. fragrans*; this treatment of *N. forsteri* is followed here since the type specimen has not been seen by me. In fact, *N. forsteri* appears to be a valid name (vide Roem. & Schult., Syst. Veg. 4:323, 1819).

Subsp. debneyi

Corolla tube 1.5-3 mm wide at top of calyx; *corolla lobes* broad (often broader than long), obtuse (rarely slightly emarginate), fused for $\frac{1}{2}$ to almost all their length. *Filaments* of upper 4 stamens (4-) 6-11 mm long, of fifth 6-10 mm long, all inserted onto corolla in proximal $\frac{1}{2}$ of tube (occasionally those of upper 4 stamens semi-adnate to corolla tube for most of their length, but fused to tube only in their proximal sections). *Capsule* splitting septicidally-septifragally and shortly loculicidally, into 4 valves. *Seed testa* with short, sharp-edged wrinkles or very wavy-edged honeycombs. (Figs. 4c, 5a).

Chromosome number: $n = 24$ (Wheeler, 1935:51).

Distribution and habitat

This subspecies occurs along the eastern regions of Queensland (south of Cairns) and New South Wales (north of Nowra) (Fig. 14). It is also found on Lord Howe Island and in New Caledonia.

The habitat of this subspecies is variable: sandy, clay, loam or rocky soils in or on rocky coastal headlands, deep gorges and cave openings, margins of rainforest, or soft-wood scrub.

Notes

The only specimen seen from New Caledonia (*Anonymous s.n.*, New Caledonia, *s.dat.* [BRI 239738]) differs from *N. debneyi* subsp. *debneyi* only in that the corolla is slightly more robust than is usual in the Australian specimens.

Two collections are from mid- and western Queensland: *J.H. Simmonds s.n.*, Woolston, 26.i.1888 (BRI 114444); and glasshouse plants grown by N.T. Burbidge, 18.ix.1959, from sample T.S.232, the original seed coll. *N.T. Burbidge 5311*, Mount Isa, 26.iv.1956 (CANB). They are representative of subsp. *debneyi* and may perhaps be relicts of a once more widespread distribution of *N. debneyi* which extended from eastern Queensland and New South Wales to western Northern Territory and included the area now occupied by subsp. *monoschizocarpa*.

Selected specimens (total seen about 126)

QUEENSLAND: *N.T. Burbidge 5561*, banks of Bullaroo Creek, Carnarvon Range, 13.ix.1956 (CANB); *M.S. Clemens s.n.*, Ogmoo, 1.xii.1947 (BRI 239778); *R. Henderson 294*, Benarkin State Forest, Blackbutt, 8.viii.1967 (BRI); *R.W. Johnson 2814*, 45 km W.S.W. of Moura, 8.ix.1964 (CANB); *L.S. Smith 3461*, Biloela, 21.x.1947 (BRI); *A. Taylor s.n.*, on range in rainforest between "The Head" and Killarney, 20.vi.1957 (BRI 5735); *C.T. White 11359*, Carnarvon Creek, 26.ix.1940 (BRI); *12488*, Marmor, 26.xi.1943 (BRI); *J.H. Willis s.n.*, at mouth of Koolanbilba Cave on eastern slope of Mt Roberts, ca 2 km east of Binna-Burra Lodge, 27.v.1961 (MEL).

NEW SOUTH WALES: *W.M. Carne s.n.*, Horse-shoe Bend, Grose Vale, 2.iii.1910 (NSW 48834); *E.F. Constable s.n.*, Eden Creek, Toonumbar State Forest, 17.iv.1947 (NSW 3724); *R. Henderson 488*, ca 32 km N.W. of Kyogle, 12.xii.1968 (BRI, NSW); *L.A.S. Johnson s.n.*, Yessabah Caves, 23.x.1959 (NSW 48815); *s.n.*, "The Blowhole", Korogoro Point, Hat Head, Jan. 1968 (NSW 141405); *F.A. Rodway 6562*, Cambewarra Range, near Bellawongarah, 29.x.1939 (NSW); *H.M.R. Rupp s.n.*, Mount Johnstone, near Paterson, 6.vi.1927 (NSW 48831).

LORD HOWE ISLAND: *L.A.S. Johnson & A. Rodd 1252*, western end of North Beach, 9.ix.1970 (NSW).

Subsp. monoschizocarpa P. Horton, subsp. nov.

Type: *J. McKean 1183*, Daly River Crossing, Daly River road (13° 46'S, 130° 41'E), 28.ix.1973 (NT, holo.; CANB? n.v., DNA n.v., NSW n.v.).

Tubus corollae ad 1.5 mm latus summo calycis. *Lobi corollae* angusti, semper longiores quam lati, acuti vel anguste obtusi, conjuncti per $\frac{1}{5}$ - $\frac{1}{3}$. *Stamina*, superiora 4 filamentis 1-2.5 mm longis (rarim longioribus), filamentum quinti staminis 2-3.5 mm longum, omnia filamenta in corolla inserta in parte superiore tubi. *Capsula* dehiscens septicide-septifraga in 2 valvis solum. *Testa seminis* favosa.

Corolla tube up to 1.5 mm wide at top of calyx; *corolla lobes* narrow (always longer

than broad), acute or narrowly obtuse, fused for $\frac{1}{5}$ - $\frac{1}{3}$ their length. *Filaments* of upper 4 stamens 1-2.5 mm long (rarely longer), of fifth 2-3.5 mm long, all inserted onto corolla in distal $\frac{1}{2}$ of tube. *Capsule* splitting septicidally-septifragally only, into 2 valves. *Seed testa* honeycombed. (Figs. 4d, 5b).

Chromosome number: $n = 24$ (from meiotic pollen mother cells; voucher: plants [ADW 54171] cultivated from seed of *C.R. Dunlop 5028*).

Distribution and habitat

This subspecies is known only from the Daly River and Reynolds River region in north-western Northern Territory (Fig. 14). From the four field collections of *N. debneyi* subsp. *monoschizocarpa*, it appears that this subspecies grows in clay soils on riverbanks.



Fig. 5. (a) *Nicotiana debneyi* subsp. *debneyi*, voucher *R.W. Johnson 2814* (CANB); (b) *N. debneyi* subsp. *monoschizocarpa*, voucher *C.R. Dunlop 5028* (ADW).

Specimens seen (all cited)

NORTHERN TERRITORY: *C.R. Dunlop* 3079, Reynolds River (13°23'S, 130°46'E), 18.ix.1973 (ADW, DNA n.v.); 5028, Daly River crossing (13°46'S, 130°42'E), 27.ix.1978 (ADW, DNA n.v.); *J. Muspratt* 92, Oolloo Station, Daly River banks, 25.ix.1962 (CANB, NT); plants cultivated at Waite Institute from seed ex *C.R. Dunlop* 5028 (details above), 14.iii. & 12.iv.1979 (ADW 54171 & 54172).

2. *N. cavicola* N.T. Burbidge, Aust. J. Bot. 8:354, fig. 7, pl. 11 fig. 2 (1960).

Type: Glasshouse plant, 9.ii.1958, grown from sample *T.S.202*, the original seed collected *N.T. Burbidge* 4774, 7 miles east of Meekatharra, W.Aust., 11.xii.1955 (CANB 79168, lecto., here proposed).

Herb to 0.7(-1.0)m high, with 1-4 (or occasionally more) leafy stems. *Indumentum* moderately dense, of glandular trichomes which are often elongate at base of plant and are ellipsoid-headed on distal parts. *Leaves* both radical and cauline, petiolate; *lamina* (1-)2.5-14(-20)cm long x (0.5-)1-12.5cm wide, broad-ovate-deltate or broad-cordiform, becoming narrowly so above; apex obtuse or acute on basal leaves, becoming acuminate or elongate-acuminate on more distal leaves; base cordate, obtuse or cuneate; margin sinuate or undulate, often denticulate; *petiole* to 7.5(-11)cm long, broadly winged and occasionally slightly auriculate at the base, insertion onto stem simple to somewhat stem-clasping. *Inflorescence* an elongate, few-branched panicle, occupying up to $\frac{2}{3}$ the length of stems; *bracts* 4-45(-70)mm long, lanceolate to linear, the lower ones leafy; *pedicels* to 26mm long in fruit. *Calyx* 7-20(-26)mm long; sepals lanceolate to linear-lanceolate, subequal to unequal, fused for $\frac{1}{3}$ - $\frac{2}{3}$ their length; intersepal membranes inconspicuous. *Corolla tube* (18-)22-45(-50)mm long, 1-3(-3.5)mm wide at top of calyx; tube proper not distinct from throat cylinder; throat cup not very distinct, slightly asymmetrical; *corolla limb* 10-35(-40)mm diameter, closing in sunlight, lobes obtuse or occasionally narrow-obtuse (rarely slightly emarginate), fused for $(\frac{1}{3}-)\frac{1}{2}$ - $\frac{2}{3}$ their length. Upper 4 *stamens* level or slightly subdidynamous, in throat cup, fifth stamen usually between the 2 of the longer pair; *filaments* of upper 4 stamens (0.4-)1-2.5(-5)mm long, of fifth (0.8-)3.5-6.5(-14)mm long and inserted onto corolla usually in distal $\frac{1}{2}$ of tube, occasionally below the middle. *Capsule* 6-12mm long, usually shorter than calyx, ovoid to ellipsoid or broadly so (length:breadth 2:1 to 3:2). *Seeds* (0.5-)0.6-0.9(-1.0)mm long, reniform or triangular- to oblong-reniform; testa with minutely-wavy-edged honeycombs. (Fig. 6a).

Chromosome number: $n = 23$ (Burbidge, 1960:356), $n = 20$ (Williams, 1975).

Distribution and habitat

N. cavicola occurs over the area between the Gascoyne River, Wiluna, Leonora and Rothsay in mid-western Western Australia (Fig. 15), and grows in sheltered areas amongst rocks on cliffs and breakaways.

Notes

Two sheets of sample *T.S.202* were present in the type folder of *N. cavicola*, neither annotated as a type by Burbidge. One sheet (CANB 79168) bears the date: 9.ii.1958, and the other (CANB 79167): 9.v.1958. In her revision, Burbidge (1960) did not refer to a specific sheet as being the type, nor did she give a date on which the cultivated type specimen was harvested. I therefore propose that the specimen with the earlier date be the lectotype, viz.: CANB 79168, coll. 9.ii.1958.

Selected specimens (total seen about 70)

WESTERN AUSTRALIA: *T.E.H. Aplin* 2528, 87km N.W. of Cue, on road to Mileura Homestead, 25.viii.1963 (ADW, PERTH); *A.M. Ashby* 2614, in rocks at Anketell Station, a mile or two south of the homestead, 13.ix.1968 (AD); *R.J. Chinnoek* 1027, Nowthanna Hill, 50km S.S.E. of Meekatharra on Sandstone road, 14.ix.1973 (AD); *C.A. Gardner s.n.*, Wannarra, Aug. 1959 (PERTH); 7797, Mt Magnet, S.E. side, 11.x.1945 (PERTH); 12035, Ninghan, 17.viii.1953 (PERTH); *A.S. George* 2741, Niagara, 21.viii.1961 (PERTH); 2838, Beeda Rockhole, 23.viii.1961 (PERTH); 4491, 16km east of Laverton, 29.vi.1963 (PERTH);

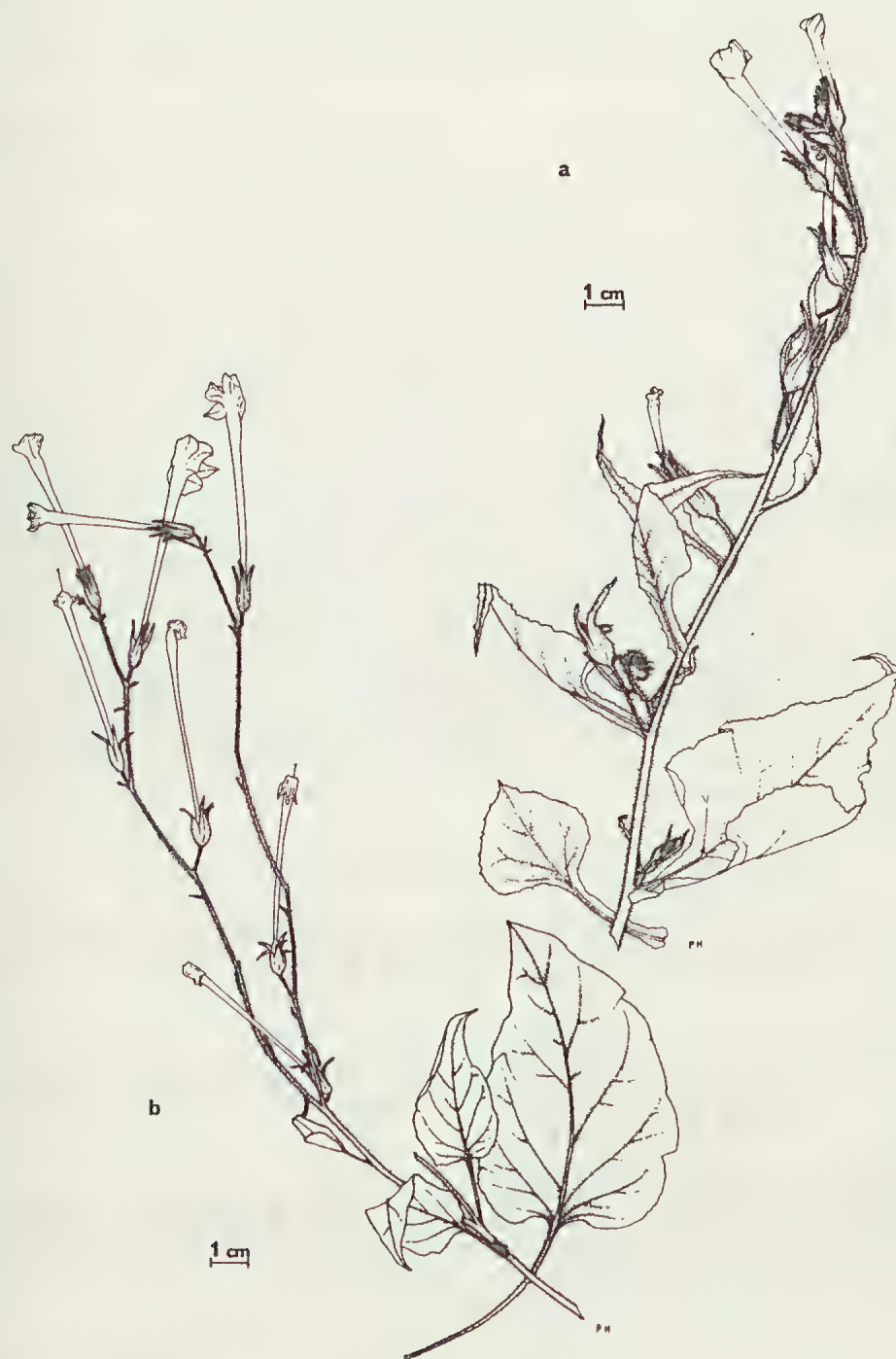


Fig. 6. (a) *Nicotiana cavicola*, voucher R.D. Pearce 112 (ADW); (b) *N. umbratica*, voucher N.T. Burbidge T.S. 302 (CANB).

5645, 72 km S.W. of Wiluna, 29.vii.1963 (PERTH); *D. Hardy s.n.*, breakaway 14 km north of Thundellara Homestead, 13.vii.1966 (PERTH); *R.D. Pearce 112*, north end of Lake Weelhamby, 30.viii.1977 (ADW). *J. Robertson s.n.*, Lake Austin, 1894 (MEL); *N.H. Speck 996A*, 16 km west of Mileura on Nookawarra road, 17.ix.1958 (BRI, CANB, MEL); *D.E. Symon 5458*, about rocky breakaway 77 km N.E. of Perrin Vale on road to Sandstone, 5.vii.1967 (ADW, CANB); 9949, 95 km south of Wiluna, 13.v.1975 (ADW).

3. *N. umbratica* N.T. Burbidge, Aust. J. Bot. 8:352, fig. 6, pl. 11, fig. 1 (1960).

Type: *E.H.M. Ealey El61*, Woodstock Station, Pilbara District, W. Aust., received Canberra May 1958 (CANB, holo.; K-photo. in ADW).

Herb to about 0.7 m high, with ?1 main stem, leafy below inflorescence. *Indumentum* sparse to dense, of glandular trichomes, globular-headed near base of plant, becoming ellipsoid-headed on more distal parts. *Leaves* mostly cauline, petiolate; *lamina* (0.7-) 2.5-12 cm long x (0.1-) 1.5-10 cm wide, broad-cordiform or ovate-deltate, becoming narrower above to narrow-ovate or occasionally lanceolate to linear; apex usually acuminate and often elongate, or may be obtuse on basal leaves; base cordate, becoming obtuse or occasionally acute above (rarely acuminate); margin entire to sinuate; *petiole* to 11 cm long, very narrowly winged to almost terete, insertion onto stem simple. *Inflorescence* an elongate, few-branched panicle, occupying up to $\frac{1}{2}$ the length of stems; *bracts* 2-20 (-35) mm long, linear or occasionally linear-lanceolate to lanceolate; *pedicels* to 16 mm long in fruit. *Calyx* (6-) 8-13 (-15) mm long; sepals lanceolate, equal or subequal, fused for $(\frac{1}{3})^{\frac{2}{5}}\text{--}\frac{3}{5}$ their length; intersepal membranes inconspicuous. *Corolla tube* (25-) 40-66 mm long, 1-2.5 mm wide at top of calyx; tube proper not distinct from throat cylinder; throat cup usually indistinct, symmetrical; *corolla limb* 20-35 mm diameter, closing in sunlight, lobes acute or occasionally narrowly obtuse, fused for $\frac{1}{4}\text{--}\frac{1}{2}$ their length. Upper 4 *stamens* usually slightly subdidynamous, in throat cup, the fifth between the two of the longer pair; *filaments* of upper 4 stamens 1.5-2.5 mm long, of fifth 2-7 mm long and inserted onto corolla in distal $\frac{1}{2}$ of tube. *Capsule* 6-10 mm long, shorter than or equalling calyx, ovoid-ellipsoid (length:breadth [5:2-]2:1 [-3:2]). *Seeds* 0.5-0.7 mm long, oblong- or trapezoid-reniform; testa irregularly honeycombed or with sharp-edged wrinkles. (Fig. 6b).

Chromosome number: $n = 23$ (Burbidge, 1960:354).

Distribution and habitat

N. umbratica has a restricted range in the western part of the Pilbara district in north-western Western Australia (Fig. 15). It grows amongst rocky outcrops in the shelter of boulders.

Notes

Morphologically, *N. umbratica* appears to be closely related to *N. cavicola*, from which it can readily be distinguished by its almost terete petioles as opposed to the broadly winged petioles of the latter.

Selected specimens (total seen about 21)

WESTERN AUSTRALIA: *N.T. Burbidge 1048*, Dingo Point, Talga River, Eginbah Station, 8.vi.1941 (PERTH); 5820, Ram Granite, Woodstock Station, 23.iv.1958 (AD, CANB, MEL); 5873, Abydos Station, 26.iv.1958 (CANB, PERTH); 5957, Hilliers Granite, Woodstock Station, 30.iv.1958 (CANB); *H. Suijtdendorp 117*, Woodstock Station, *s.dat.* (PERTH).

4. *N. occidentalis* Wheeler, Univ. Calif. Publ. Bot. 18:52 (1935).

Type: *E. Mjöberg s.n.*, Port Hedland, W. Aust., 11.viii.1911 (NSW 47226, holo.).

Herb to 0.7 (-1.3) m high, with 1 to several (up to 6) leafy stems. *Indumentum* a dense pubescence of sticky, ellipsoid-headed glandular hairs (usually a few simple glandular hairs present at base of plant). *Leaves* both radical and cauline, basal ones petiolate,

others soon becoming sessile above; *lamina* (1-)2-14(-20) cm long x 0.5-6(-9) cm wide, elliptic or narrowly so, becoming elliptic- or ovate-pandurate or narrowly so above, finally lanceolate or occasionally linear; apex obtuse or acute on basal leaves, becoming narrower above, to acuminate; base of basal leaves continuous with petiole, of more distal leaves auriculate and somewhat stem-clasping; margin entire to sinuate; *petiole* to 5(-16) cm long, broadly winged, insertion onto stem usually slightly stem-clasping. *Inflorescence* an elongate, few-branched panicle, occupying up to $\frac{1}{2}$ the length of stems or occasionally more, to almost all of stems, leafy in lower part; *bracts* (2-)4-50 mm long, often lanceolate or narrow-ovate and auriculate at base of inflorescence, becoming narrower more distally to linear-lanceolate or linear, usually leafy in lower part of inflorescence; *pedicels* to 28(-40) mm long in fruit. *Calyx* (5-)7-14 mm long; sepals lanceolate to linear-lanceolate, equal or subequal, fused for $\frac{1}{2}$ - $\frac{3}{4}$ (- $\frac{5}{6}$) their length; inter-sepal membranes usually inconspicuous. *Corolla limb* 10-25 mm diameter, closing in sunlight, lobes emarginate, fused for $\frac{1}{4}$ - $\frac{4}{5}$ their length. *Filaments* of upper 4 stamens 1-5 mm long. *Capsule* 7-14 mm long, equalling calyx or slightly shorter or longer, ovoid to ellipsoid or narrowly so (length: breadth 2:1 to 5:2, rarely to 7:2).

Notes

N. occidentalis, particularly subsp. *obliqua*, has a strong tendency to produce cleistogamous flowers, in which the corolla is much narrowed and shortened and may even be shorter than the calyx at maturity. A wide range in corolla tube length of chasmogamous flowers occurs in subsp. *obliqua*, the tube usually being either short (about 20 mm or less) or long (about 25 mm or more), with occasional specimens between 20 and 25 mm. There appears to be no correlation between tube length and habitat (as given in herbarium labels), geographical distribution, or physical state of the plant. In shorter flowers, the stamens tend to become level and the throat cup symmetrical, although occasional short-flowered specimens occur with a distinctly asymmetrical throat cup and strong subdidymy of stamens.

Subsp. *occidentalis*

Corolla tube (26-)34-48(-52) mm long, (1-)1.5-2.5(-4) mm wide at top of calyx, tube proper not distinct from throat cylinder; throat cup indistinct to moderately distinct, symmetrical. Upper 4 *stamens* level, in throat cup; *filament* of fifth stamen 3-8 mm long and inserted onto corolla in distal $\frac{1}{2}$ of tube. *Seeds* 0.6-0.9 mm long, acutely angled or reniform or occasionally C-shaped, testa irregularly honeycombed or wrinkled, the wrinkles occasionally transversely aligned across the seed. (Fig. 7a).

Chromosome number: unknown? Goodspeed (1954:479) gave a haploid number of 21 for *N. occidentalis*, but referred to only one specimen as having this number, and this in fact is *N. occidentalis* subsp. *obliqua*. Burbidge (1960:347) listed *N. occidentalis* subsp. *occidentalis* with taxa having a haploid number of 21.

Distribution and habitat

N. occidentalis subsp. *occidentalis* has a restricted range in Western Australia along the coast and on offshore islands from Port Hedland south to the Exmouth Gulf (Fig. 16). Burbidge (1960) indicated that its range extended considerably further south, but most of the specimens I have seen from this region are subsp. *obliqua* or subsp. *hesperis*. It grows in sandy or rocky areas, often along creeklines or in the shelter of boulders or trees.

Selected specimens (total seen about 46)

WESTERN AUSTRALIA: *A.M. Ashby* 2943, North-West Coastal Highway, north of Minilya River, 16.viii.1969 (AD); *J.S. Beard* 2876, Wittenoom Gorge, 18.viii.1963 (PERTH); *A.C. Beaglehole* 11567, Point Samson, 17.viii.1965 (Beaglehole Herbarium); *N.T. Burbidge* 1077, Yandicoogina Creek, Mount Edgar Station, 10.vi.1941 (PERTH); *W.H. Butler* 22, Barrow Island, 18.viii.1973 (PERTH); *R.C. Carolin* 7742, Fig Tree Well, Yampire Gorge, 8.viii.1970 (SYD); 7881, north of Karratha, Nickol Bay, 12.viii.1970 (PERTH,

SYD): *H. Demarz* 4823, 8 km south of Bullara Station turn-off, 3.xi.1973 (PERTH); *A.S. George* 1149, 16 km south of Onslow, 28.viii.1960 (PERTH); 1293, 14 km north of Learmouth, 30.viii.1960 (PERTH); 2495, Cape Range, road to Number 3 & 4 Wells, 2.vi.1961 (PERTH); 6605, ca 8 km south of Exmouth township, 25.v.1965 (PERTH); *D.W. Goodall* 629, Ashburton Island, 5.viii.1963 (PERTH); *Hill s.n.*, Trimouille Island, 10.xi.1953 (CANB 28977).



Fig. 7. (a) *Nicotiana occidentalis* subsp. *occidentalis*, voucher *D.W. Goodall* 629 (PERTH); (b) *N. occidentalis* subsp. *obliqua*, voucher *P. Horton s.n.* (ADW 53711), cultiv. from seeds of *A.C. Beaglehole* 59571; (c) *N. occidentalis* subsp. *hesperis*, voucher *T.E.H. Aplin* 3207 (PERTH).

Subsp. *obliqua* N.T. Burbidge, Aust. J. Bot. 8:364, pl. 8 fig. 2 (1960).

Type: *R. Helms s.n.*, Victoria Desert, Camp 53, W. Aust., 15.ix.1891 (NSW 47228, holo.; AD 97433234 & 97433241; MEL *s.n.*).

N. occidentalis Wheeler (pro parte: *R. Helms s.n.*, Greenough, W. Aust., Oct. 1898 [NSW 47227, PERTH *s.n.*]).

Corolla tube 15-36(-40) mm long, (1-) 1.5-3(-4) mm wide at top of calyx; tube proper not distinct from throat cylinder; throat cup not very distinct, symmetrical to strongly asymmetrical. Upper 4 *stamens* level to subdidynamous, in throat cup, or if subdidynamous then occasionally the longer pair or both pairs slightly exserted; if upper 4 *stamens* subdidynamous, the fifth between the 2 of the shorter pair; *filament* of fifth stamen 3.5-6 mm long and inserted onto corolla in distal $\frac{1}{2}$ of tube or about half way down. *Seeds* 0.6-0.9 mm long, acutely angled or reniform or occasionally C-shaped; testa irregularly honeycombed or wrinkled, the wrinkles occasionally transversely aligned across the seed. (Fig. 7b).

Chromosome number: $n = 21$ (Burbidge, 1960:348).

Distribution and habitat

N. occidentalis subsp. *obliqua* extends from near the coast in mid-western Western Australia to southern Northern Territory and scattered through most of the drier regions of South Australia, with one collection from western Queensland and one from south western New South Wales (Fig. 16). It grows in sandy or rocky areas, often along creek-lines or in the shelter of boulders or trees.

Selected specimens (total seen about 226)

WESTERN AUSTRALIA: *T.E.H. Aplin* 3295, Monkey Mia, 10.vii.1970 (PERTH); *H. Demarz* 4427, 8 km south of Hamersley Station, 26.viii.1973 (PERTH); *A.S. George* 5292, Winburn Rocks, 22.vii.1963 (PERTH); 9016, 11 km west of Dovers Hills, 27.vii.1967 (PERTH); *P.K. Latz* 954, ca 45 km S.S.W. of Docker River Settlement, 4.xi.1970 (CANB, NT); *R. Melville* 4058, Mt Magnetic, by Lake Yindarlgooda, 12.vii.1953 (AD, BRI, MEL, NSW, PERTH); *R.D. Royce* 2001, Mibbeyan Creek, 10.vi.1947 (PERTH).

NORTHERN TERRITORY: *G. Chippendale s.n.*, Charlotte Waters, 6.vii.1955 (NSW 48696); *P.K. Latz* 4104, Henbury Station, 23.viii.1973 (AD, CANB, NT); 4188, Dean Range, 26.viii.1973 (AD, NT); 5063, Mt Fraser, 29.iv.1974 (ADW, NT); *D.J. Nelson* 2213, Emily Gap, 6.vi.1972 (ADW, CANB).

QUEENSLAND: *S.L. Everist* 3318, Headingly Station, 2.xii.1947 (BRI, CANB).

NEW SOUTH WALES: *G.M. Cunningham* 3381, South Muluru Station, 15.iv.1975 (NSW).

SOUTH AUSTRALIA: *A.S. George* 5165, Cave Hill, 20.vii.1963 (PERTH); *L. Haegi* 1283, ca 2 km S.W. of Pondana Dam, 23.viii.1977 (ADW); *P. Horton* 196, hillside just north of the Peake Telegraph Repeater Station, 5.x.1978 (ADW); *T.R.N. Lothian* 647, ca 8 km W.N.W. of Cordillo Downs Homestead, 29.viii.1960 (AD); 5544, Maralinga Village, 15.vii.1972 (AD); *D.E. Symon* 6071, Paralana Springs, 24.viii.1968 (ADW).

Subsp. *hesperis* (N.T. Burbidge) P. Horton, comb. nov.

Type: *N.T. Burbidge* 6494A, Rocky Pool, Gascoyne River, 35 miles east of Carnarvon, W. Aust., 3.ix.1959 (CANB, holo.; K-photo. in ADW).

N. occidentalis Wheeler (pro parte: *F.S. Carey s.n.*, near Roebourne, W. Aust., Aug. 1884 [MEL *s.n.*]).

N. hesperis N.T. Burbidge, Aust. J. Bot. 8:361, fig. 9, pl. 15 (1960), basionym.

Corolla tube 11-18 mm long, 1.5-3 mm wide at top of calyx; tube proper slightly narrower than throat cylinder; throat cup indistinct, symmetrical. Upper 4 *stamens* level, in throat cup; *filament* of fifth stamen 3.5-7 mm long and inserted onto corolla in proximal $\frac{1}{2}$ of tube or about half way down. *Seeds* 0.5-0.8 mm long, C-shaped or usually bent into a U-shape, occasionally crested along outer surface; testa wrinkled, the wrinkles long and aligned transversely across the seed. (Figs. 3, 7c).

Chromosome number: unknown? Burbidge (1960:361) stated that the chromosome number was unknown, but again listed it elsewhere (p. 347) with taxa having a haploid number of 21.

Distribution and habitat

This subspecies occurs in Western Australia, mainly along the coast and on offshore islands from the Minilya River south to about mid-way between Geraldton and Perth, with one collection further north from near Roebourne and one well inland, near Leonora (Fig. 16). It grows in sandy or rocky areas, often along creeklines or in the shelter of boulders or trees.

Notes

The only reasonably consistent feature distinguishing *N. hesperis* from *N. occidentalis* was found to be the nature of the seeds, without which it is impossible to separate with any confidence the former from short-flowered *N. occidentalis* subsp. *obliqua* with level stamens. Occasional specimens of subspecies *obliqua* and *occidentalis* (either within or outside the range of *N. hesperis*) possess seeds which are reminiscent of those of *N. hesperis*, particularly in the transverse alignment of wrinkles across the testa; e.g. T.E.H. *Aplin* 81, Boolathana Station, W. Aust. 5.xi.1963 (AD, ADW, PERTH); D.G. *Wilcox* s.n., Mt Augustus Station, W. Aust., 7.vii.1970 (PERTH). The seeds of *N. hesperis* are themselves dramatically variable, in the presence or absence of a crest. For these reasons, therefore, it was felt that *N. hesperis* is not sufficiently distinct and that its distinctive features are not sufficiently stable to justify specific rank. It is therefore here reduced to a subspecies of *N. occidentalis*. The crested nature of the seeds of some specimens of *N. occidentalis* subsp. *hesperis* was not seen in any other Australian *Nicotiana*; it does not appear to be correlated with any other morphological features and may be present or absent within the one population.

Selected specimens (total seen about 42)

WESTERN AUSTRALIA: T.E.H. *Aplin* 2296, 16 km south of Leonora on Menzies road, 17.viii.1963 (ADW, PERTH); N.T. *Burbidge* 6445, 74 km north of Murchison River bridge on Carnarvon road, 1.ix.1959 (CANB); 6455, near Woodleigh Station Homestead, 2.ix.1959 (BRI, CANB, MEL, NSW); 6480, Wooramel River Bridge, Carnarvon road, 2.ix.1959 (CANB); 6519, between Greenough and Dongara, 5.ix.1959 (AD, BRI, CANB, MEL); W.H. *Builer* s.n., Monkey Mia, Aug. 1957 (PERTH); R.C. *Carolin* 3257, shores of Lharidon Bight, 26.viii.1961 (SYD); A.S. *George* 11386, ca 8 km south of homestead, Dirk Hartog Island, 2.ix.1972 (PERTH); R.D. *Royce* 6014, Bernier Island, 23.vii.1959 (PERTH); G.M. *Storr* s.n., North Island, Houtman Abrolhos, 6.ix.1959 (PERTH); s.n., 19 km north of Jurien Bay, 22.x.1961 (PERTH 5758/61).

5. *N. benthamiana* Domin, Biblioth. Bot. 89:1145, pl. 37 fig. 1 (1929).

Type: *Bynoe* s.n., N.W. coast, Australia, *s. dat.* (collected on the voyage of HMS "Beagle", 1839-40, under command of Capts Wickham & Stokes (K-photo. in ADW, hol.)).

N. suaveolens var. *cordifolia* Benth., Fl. Austral. 4:470 (1868).

Type: as for *N. benthamiana*.

Leafy herb to 0.6(-1.5) m high, with one or a few leafy stems often branched near the base. *Indumentum* on all parts a moderately dense pubescence of glandular trichomes. *Leaves* mostly cauline, basal ones petiolate, more distal ones soon becoming subsessile to sessile; *lamina* (0.7-) 1.5-14(-23) cm long x (0.3-) 1-9(-15) cm wide, broad-ovate (occasionally suborbicular) to narrow-ovate (occasionally narrow-elliptic) above; apex obtuse on basal leaves, becoming acute and often acuminate on most distal leaves (occasionally elongate-acuminate); base obtuse or cuneate (occasionally shallowly cordate); margin entire or slightly sinuate or denticulate; *petiole* to 6 cm long, moderately broadly to narrowly winged, insertion onto stem simple or occasionally slightly stem-clasping. *Inflorescence* of solitary, interfoliar flowers distributed along most of the length of stems; *pedicels* to 15 mm long in fruit. *Calyx* (5-) 8-17 mm long; sepals linear-lanceolate to lanceolate or narrow-elliptic, subequal to unequal, fused for $\frac{1}{3}$ - $\frac{1}{2}$ ($\frac{3}{5}$) their length, the distal portions usually loose and spreading or recurved; intersepal membranes

inconspicuous. *Corolla tube* (19-)24-55(-60) mm long, up to 2(-2.5) mm wide at top of calyx; tube proper not distinct from throat cylinder; throat cup not very distinct, symmetrical or slightly asymmetrical; *corolla limb* (7-)10-21 mm diameter, closing in sunlight, lobes obtuse to slightly emarginate (occasionally narrow-obtuse to broad-acute), fused for $\frac{1}{3}$ - $\frac{3}{4}$ their length. Upper 4 *stamens* usually slightly subdidynamous, in throat cup, fifth stamen usually between the 2 of the longer pair; *filaments* of upper 4 stamens 0.3-2.5 mm long, of fifth 5-10 mm long and inserted onto corolla in distal $\frac{1}{2}$ of tube. *Capsule* 6-11 (-13) mm long, shorter than or occasionally equalling calyx, ovoid to ellipsoid or broadly so (length:breadth 2:1 or 3:2, occasionally 1:1). *Seeds* 0.5-0.7 mm long, oblong- or trapezoid-reniform; testa with wavy-edged (rarely straight-edged) honeycombs to serpentine wrinkles. (Figs. 4g, 8a).

Chromosome number: $n = 19$ (Goodspeed, 1954:485).

Distribution and habitat

The distribution of *N. benthamiana* is patchy, and is widespread across the northern half of Australia from north-western Western Australia across the Northern Territory to western Queensland (Fig. 15). The species grows in sheltered areas amongst rocks or in caves on rocky slopes. It usually occurs on low rocky hills and outcrops, which may partly explain its apparently patchy distribution.

Notes

As noted by Burbidge (1960), two types of seed-coat ornamentation pattern can be seen in this species. In the majority of specimens the pattern is of wavy-edged honeycombs or wrinkles, but in four specimens: *N.T. Burbidge T.S. 299*, *K.F. Keneally 4181*, *M. Lazarides 6292* and *N.B. Tindale s.n.* (AD 97610338) (and apparently in the holotype [Burbidge, 1960]) the pattern is reticulate. These latter specimens all occur in the northern-most region of Western Australia.

N. benthamiana is not known to occur in South Australia, despite its presence in southern Northern Territory. There are two collections: *D.E. Symon 9294* and *9354*, which resemble *N. benthamiana* and are both from a population at Dalhousie Springs in the far north of South Australia. (An additional specimen, *D.E. Symon 9895*, was cultivated from seedlings from the same site). These specimens differ from *N. benthamiana* in that they are unusually succulent and sprawling, and the corolla is considerably larger (the tube 45-90 mm long and the limb usually more than 30 mm in diameter). Chromosome counts from meiotic pollen mother cells of plants grown at the Waite Institute indicate that the haploid number is probably 21, not 19 as in *N. benthamiana*. These collections may therefore represent a new species, but more detailed study would be desirable to establish this and to illuminate their relationship with *N. benthamiana*. A naturally-occurring hybrid between this Dalhousie Springs material and *N. velutina* is discussed in the section on hybrids.

N. benthamiana was one of the species highly prized by certain aborigines for chewing (Latz, 1974).

Selected specimens (total seen about 117)

WESTERN AUSTRALIA: *W.R. Barker 2078*, Oakover River, Upper Carawine Pool, 24.viii.1977 (AD); *J.V. Blockley 989*, 14 km N.E. of Wyloo Station, near Belvedere Mine, 27.ix.1968 (PERTH); *N.T. Burbidge 1191*, Mount Edgar Station, 13.vi.1941 (PERTH); *G.W. Carr 4284*, north end of Windjina Gorge, Napier Range, 27.viii.1974 (Beaglehole Herbarium); *4927*, Hancock Gorge, Hamersley Range National Park, 10.viii.1974 (Beaglehole Herbarium); *R.J. Chinnock 894*, 55.6 km S.E. of Glenayle Homestead on Carnegie to Glenayle Station road, 9.ix.1973 (AD); *Fisheries Department ?174*, Dolphin Island, Dampier Archipelago, 20.vi.1970 (PERTH); *A.S. George 8818*, Glen Cumming, Rawlinson Range, 21.vii.1967 (MEL, NT, PERTH); *8996*, Dovers Hills, northern Gibson Desert, 27.vii.1967 (PERTH); *R.A. Gould s.n.*, Picture Hill, 209 km N.W. of Well 35 (Canning Stock Route), 24.iv.1967 (PERTH); *K.F. Keneally 4181*, Craticus Falls, Drysdale River National Park, 10.viii.1975 (PERTH); *M. Lazarides 6292*, 11 km E.S.E. of Halls Creek township, 9.vii.1959 (AD, BRI, CANB, MEL, NSW, PERTH).

NORTHERN TERRITORY: *A.C. Beaglehole* 50887, The Granites, 19.v.1976 (Beaglehole Herbarium); *G. Chippendale s.n.*, near Alcoora Spring, Tobermorey Station, 10.x.1955 (BRI 32505, CANB 98167, NSW 60705, NT 1799); *N.M. Henry* 792, Seigal Creek area north of China Well, 1.vi.1973 (BRI, CANB, NT); *P.K. Latz* 642, Old Huckitta Homestead, 20.vii.1970 (NT); 2662, Mount Doreen Station, 14.i.1972 (NT); 4187, Dean Range, 26.viii.1973 (CANB, NT); *R.A. Perry* 2269, 64 km west of Wavehill Police Station, 27.vi.1949 (AD, BRI, CANB, NSW, NT).

QUEENSLAND: *S.T. Blake* 11527, Duchess, 18.v.1936 (BRI).



Fig. 8. (a) *Nicotiana benthamiana*, voucher *P. Horton s.n.* (ADW 51287), cultiv. from seeds of *P.K. Latz* 6524; (b) *N. excelsior*, voucher *D.E. Symon* 3336 (ADW).

6. *N. excelsior* (J.M. Black) J.M. Black, Trans. R. Soc. S. Aust. 50:286 (1926).

Type: *S.A. White s.n.*, Mt Carminia (i.e. Carmeena), Everard Range, S. Aust., 12.viii.1914 (AD 97807202, lecto., here proposed; NSW 141364).

N. suaveolens var. *excelsior* J.M. Black, Trans. R. Soc. S. Aust. 39:835, pl. 63 fig. 2, pl. 70 (1915), basionym.

N. macrocalyx Domin, Biblioth. Bot. 89:1147, pl. 36 figs. 9-10 (1929).

Type: *R. Helms s.n.*, Elder Exploring Expedition Camp 19, Birksgate Range, S. Aust., 12.vii.1891 (K-photo. in ADW, holo.; AD; MEL; none held at PR).

Leafy herb to 1 (-1.65) m high, with 1 leafy main stem (rarely more). *Indumentum* on bracts, pedicels and calyx of sparse eglandular trichomes with inflated cells, often tuberculate; stems and leaves glabrous, or a few tuberculate trichomes may be present on leaf margins. *Leaves* mostly cauline, basal ones shortly petiolate to subpetiolate, soon becoming sessile; *lamina* (1.5-) 3-15 (-25) cm long x (0.5-) 1-8 (-14) cm wide, elliptic or ovate or narrowly so (rarely broadly), the basal leaves often obovate, the most distal ones often narrow-elliptic or lanceolate; apex acuminate, acute or obtuse; base decurrent down stem (continuous with petiole on basal leaves); margin entire or slightly sinuate, occasionally denticulate due to scattered tuberculate trichomes; *petiole* broadly winged, insertion on stem decurrent, or stem-clasping if basal leaves. *Inflorescence* an elongate, few-branched panicle, occupying less than $\frac{1}{2}$ the length of stems (usually only the distal portions); *bracts* 2-19 (-40) mm long, basal ones occasionally leafy; *pedicels* to 23 mm long in fruit. *Calyx* (13-) 16-26 (-32) mm long; sepals linear to linear-lanceolate, subequal to unequal, fused for ($\frac{1}{4}$ -) $\frac{1}{3}$ - $\frac{3}{4}$ their length; intersepal membranes long but not particularly conspicuous. *Corolla tube* (27-) 39-67 (-80) mm long, (1-) 2-4 (-5) mm wide at top of calyx; tube proper not distinct from throat cylinder; throat cup indistinct, symmetrical or often slightly asymmetrical; *corolla limb* 20-35 (-52) mm diameter, closing in sunlight, lobes obtuse (rarely slightly emarginate), fused for $\frac{1}{3}$ - $\frac{3}{4}$ their length. Upper 4 *stamens* level or slightly subdidynamous, in throat cup or occasionally slightly exerted, fifth stamen between the 2 of the longer pair; *filaments* of upper 4 stamens 0.5-1.5 (-2.5) mm long, of fifth 6.5-15 mm long and inserted onto corolla in middle or proximal $\frac{1}{2}$ of tube. *Capsule* 12-20 mm long, usually shorter than calyx (rarely slightly longer), ellipsoid to ovoid-ellipsoid (length:breadth 5:2 to 2:1). *Seeds* 0.8-1.3 mm long, reniform or acutely angled; testa honeycombed or occasionally with wavy-edged honeycombs (rarely almost wrinkled). (Fig. 8b).

Chromosome number: $n = 19$ (Goodspeed, 1954:469).

Distribution and habitat

This species is restricted to the range systems of north-western South Australia and southern Northern Territory, where it grows in rocky gullies and creeklines (Fig. 15). Two geographically anomalous specimens were collected well outside this area. One is a Robert Helms collection from the Fraser Range in southern Western Australia, 23.x.1891 (AD 97433242, no duplicates in other herbaria were found) and the other was collected by Max Koch at Mt Lyndhurst in mid-northern South Australia, Aug. 1899 (AD 97602103). If these were in fact collected at the stated localities, they might possibly represent populations established from material brought from elsewhere by aborigines, perhaps in trade with other aboriginal tribes. A collection made at Evelyn Downs, South Australia (*E.H. Ising s.n.*, 20.ix.1952, AD 97413288) is annotated "... said by natives Hector and Jerry not native of this place but coming from a long way N.W. (? Everard Range). Evidently grown from material obtained for chewing.", which indicates that this species is or was transported by aborigines from one area to another.

Notes

Type specimens of *N. excelsior* are held at both AD and NSW, and Black (1926) did not specify a particular specimen as the holotype. The NSW specimen lacks the numerous

notes and drawings of the AD specimen, and appears not to have been annotated by Black at all, so the AD specimen is here proposed as the lectotype.

N. excelsior is a large and attractive species, and one of the most favoured by aborigines for chewing (Latz, 1974). It is unusual amongst the Australian species in the strongly decurrent nature of its leaves (a condition occasionally found in robust specimens of *N. gossei*, but never to the extent as in *N. excelsior*).

Selected specimens (total seen about 125)

NORTHERN TERRITORY: *E. Giles s.n.*, Glen of Palmis, *s. dat.* (MEL); *R.A. Goulds s.n.*, Petermann Range at W.A.-N.T. border, 29.ix.1966 (PERTH); *P.K. Latz 894*, Mann Ranges, 48 km E.N.E. of Mt Davies Camp, 31.x.1970 (AD, CANB, NT); *7116*, Chewings Range, 26.v.1977 (ADW); *D.E. Symon s.n.*, Mt Olga, 12.vi.1953 (ADW 9669).

SOUTH AUSTRALIA: *A.C. Beauglehole 25480*, Everard Ranges, Mt Illbillee area, 27.vi.1968 (Beauglehole Herbarium); *J.B. Cleland s.n.*, Musgrave Range, rock-hole ca 13 km north of Ernabella, 16.viii.1933 (AD 95631001 & 95631002); *G.C. Cornwall 199*, Carmeena Rockhole, 35 km S.W. of Everard Park Homestead, 4.vi.1972 (AD); *N. Forde 902*, 16 km north of Everard Park Homestead, 5.ix.1957 (AD, NT); *914*, 64 km W.S.W. of Everard Park Homestead, 6.ix.1957 (NT); *R. Helms s.n.*, Birksgate Range, 12.vii.1891 (AD 97433244 & 97809249, *K s.n.*); *R.H. Kuchel 422*, 6 km west of Mt Woodroffe, 11.viii.1962 (AD); *D.E. Symon 2562*, Mt Lindsay, 6.viii.1962 (AD); *3336*, creekline near Victory Well, Everard Ranges, 16.ii.1965 (ADW, CANB); *F.T. Turvey s.n.*, Ernabella, 21.v.1966 (AD 97628362); *D.J.E. Whibley 1122*, Amoorinyinna Hill, 13.ix.1963 (AD); *Woskett s.n.*, Oodnadatta, 14.x.1955 (AD 97413289).

7. *N. amplexicaulis* N.T. Burbidge, Aust. J. Bot. 8:359, fig. 8, pl. 13 fig. 1 (1960).

Type: *N.T. Burbidge 5562*, Carnarvon Range, 63 miles south of Rolleston, Queensland, 13.ix.1956 (CANB, holo.; AD; K-photo. in ADW; MEL; NSW).

Herb to 1(-1.3) m high, with 1 or a few leafy stems. *Indumentum* on all parts a soft, dense pubescence of eglandular trichomes. *Leaves* mostly cauline, sessile except for the petiolate ones near the base; *lamina* (1-)2-22(-30) cm long x (0.5-)1-12(-19) cm wide, elliptic or broadly so, becoming pandurate above, to narrow-elliptic or lanceolate and auriculate at base of inflorescence; apex obtuse on basal leaves, becoming acute, to acuminate on most distal leaves; base obtuse or cuneate on basal leaves, to auriculate on most distal leaves; margin entire to sinuate; *petiole* to 5(-8) cm long, broadly winged, somewhat stem-clasping and auriculate at the base. *Inflorescence* an elongate, few-branched panicle, occupying less than half the length of stems; *bracts* 3-15(-35) mm long, lanceolate to linear-lanceolate, occasionally the lowermost broader and more foliose; *pedicels* to 18 mm long in fruit. *Calyx* 7-11(-14) mm long; sepals lanceolate, equal to unequal, fused for half their length; intersepal membranes inconspicuous. *Corolla tube* 15-20 mm long, 2-3(-3.5) mm wide at top of calyx; tube proper distinctly narrower than throat cylinder; throat cup indistinct, symmetrical; *corolla limb* 6-12.5 mm diameter, closing in sunlight, lobes obtuse to emarginate, fused for half to almost all their length. Upper 4 *stamens* usually slightly subdidynamous, rarely equal, in throat cup or the longer pair slightly exerted, fifth stamen between the 2 of the longer pair; *filaments* of upper 4 stamens 0.5-2.5 mm long, of fifth 8-11 mm long and inserted onto corolla in proximal half of tube. *Capsule* (5-)6-9 mm long, equalling or shorter than calyx (rarely slightly longer), ellipsoid to ovoid-ellipsoid or broadly so (length:breadth 2:1 to 3:2). *Seeds* 0.6-0.9 mm long, reniform or oblong-reniform or L-shaped; testa with short, round-edged wrinkles. (Fig. 9a).

Chromosome number: $n = 18$ (Burbidge, 1960:360)

Distribution and habitat

N. amplexicaulis is apparently restricted to the Carnarvon Range and nearby ranges to its east, in southern Queensland (Fig. 14). It grows in the shelter of rocks on sandstone cliffs and at cave entrances.

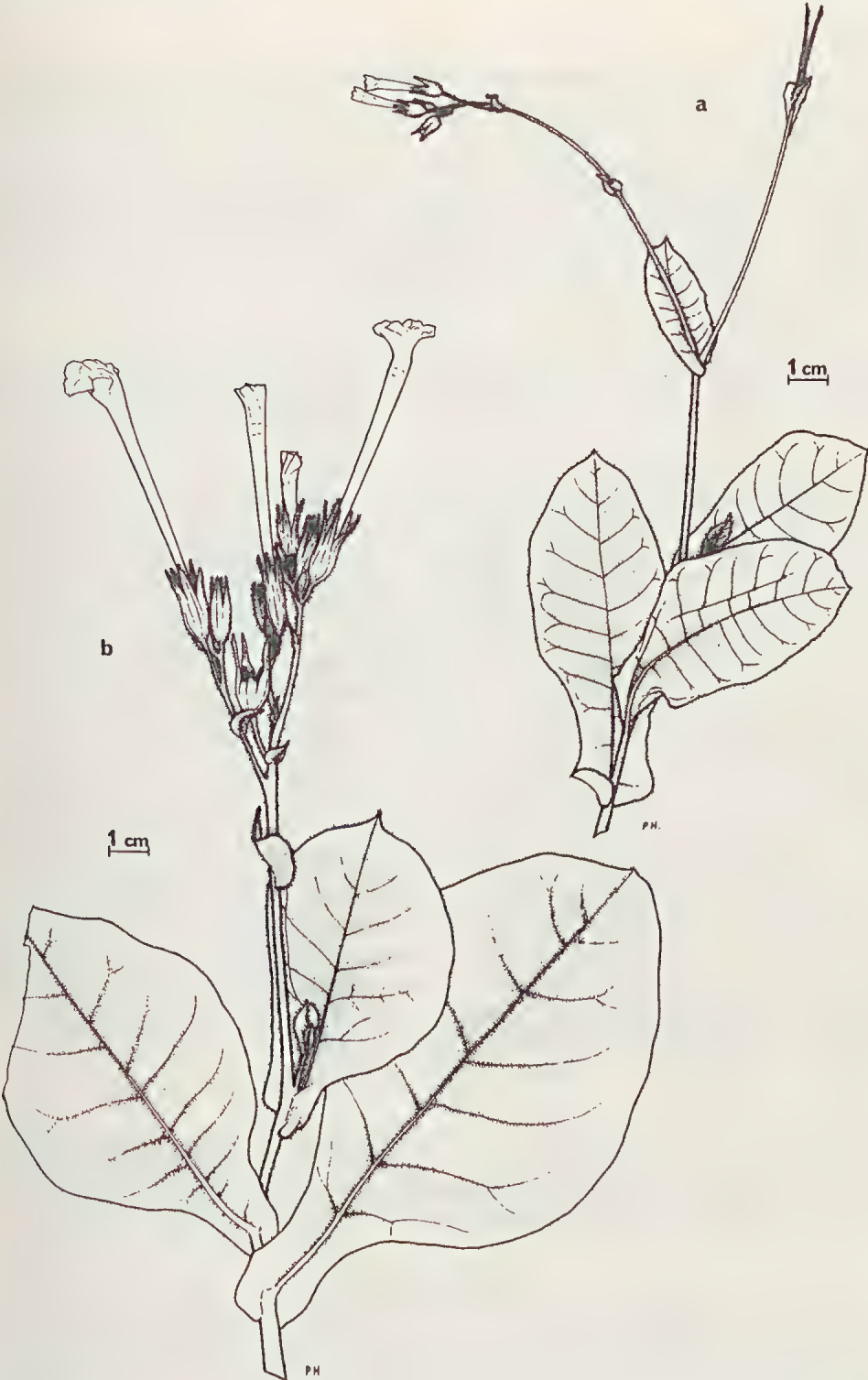


Fig. 9. (a) *Nicotiana amplexicaulis*, voucher N.T. Burbidge T.S. 111 (CANB); (b) *N. gossei*, voucher P.K. Latz s.n. (NT 12077).

Notes

In morphology this species appears to be closely related to *N. gossei*. It differs from the latter in that the flowers are very much smaller and the plants generally less robust.

Specimens seen (all cited)

QUEENSLAND: *N. T. Burbidge* 5560, Carnarvon Range, 84 km south of Rolleston, 13.ix.1956 (AD, CANB, NSW); *T.S.111*, Dec. 1955, cultivated from seed coll. M.S. Stevens, Moolayember (BRI, CANB, K, MEL, NSW); *C.H. Gittins* 369, Carnarvon Range, Aug. 1960 (BRI); *F.D. Hockings* 491, Isla Gorge, ca 28 km S.W. of Theodore, 19.viii.1973 (BRI); *M. Olsen & N.B. Byrnes* 3560, Glenaughton-Mapala road, 26.v.1977 (BRI); *W.F. Snewen s.n.*, Moolayember Creek, 93 km north of Injune, March 1948 (BRI 239743); *M.S. Stevens s.n.*, Moolayember region, Dec. 1954 (BRI 230232, CANB 30345).

8. *N. gossei* Domin, Biblioth. Bot. 89:1146, pl. 36 figs. 2-5 (1929).

Type: *Gosse* 243, centre of South Australia (comm. R. Schomburgk, May 1874) (K-photo. in ADW, holo.? note: Goodspeed [1954:467] gave the type specimen as being held at MEL, but I found no specimen of the type collection there. No specimen is held at PR).

Leafy herb to 1(-2.1) m high, with 1 or a few leafy stems, often woody at the base. *Indumentum* on all parts a dense pubescence of eglandular and glandular trichomes, often woolly in appearance. *Leaves* mostly cauline, basal ones petiolate to subpetiolate, others sessile; *lamina* (1.5-) 5-25(-35) cm long x (0.5-) 2-12(-16) cm wide, broad-elliptic (occasionally obovate), becoming narrow-elliptic to lanceolate above and usually pandurate; apex usually obtuse on basal leaves, becoming acute, usually to acuminate on most distal leaves; base of cauline leaves auriculate and stem-clasping; margin entire to sinuate, occasionally undulate; *petiole* to 5(-8) cm long, broadly winged, auriculate and stem-clasping at the base. *Inflorescence* a few-branched panicle, usually occupying only distal portions of stems; *bracts* (3-) 5-15(-50) mm long, linear to lanceolate, occasionally the basal ones leafy; *pedicels* to 17(-21) mm long in fruit. *Calyx* (12-) 15-27(-31) mm long; sepals linear-lanceolate, occasionally linear (rarely lanceolate), subequal to unequal, fused for $(\frac{1}{4}-\frac{2}{5}-\frac{3}{5})$ their length; intersepal membranes inconspicuous. *Corolla tube* (26-) 30-65(-77) mm long, (1-) 2-4(-5) mm wide at top of calyx; tube proper not distinct from throat cylinder; throat cup usually indistinct, symmetrical or almost so; *corolla limb* 15-35 mm diameter, closing in sunlight, lobes obtuse or occasionally shallow-emarginate, fused for $\frac{1}{2}$ their length. Upper 4 *stamens* level or almost so, in throat cup (rarely slightly exerted); *filaments* of upper 4 stamens 0.5-5.5 mm long, of fifth 2-15 mm long and inserted onto corolla in distal $\frac{1}{2}$ of tube or to just below half way down. *Capsule* (8-) 10-16 mm long, shorter than calyx, ellipsoid to ovoid (length:breadth 2:1 to 3:2). *Seeds* (0.6-) 0.7-0.9(-1.0) mm long, acutely angled or reniform to oblong-reniform; testa irregularly honeycombed, or wrinkled. (Fig. 9b).

Chromosome number: $n = 18$ (Wheeler, 1935:54).

Distribution and habitat

N. gossei grows in pockets of fertile soil, often sandy, amongst rocks on the major range systems of southern Northern Territory and north-western South Australia (Fig. 14). It usually occurs high up on the main ranges, rather than on small rocky hill-sides and outcrops where *N. benthamiana* can be found (P.K. Latz, pers. comm. 1979).

Notes

Burbidge (1960) noted that there was a group of unusually depauperate specimens from western Queensland; these are in fact *N. megalosiphon* subsp. *sessilifolia*, the cauline leaves of which characteristically have slightly auriculate bases, reminiscent of *N. gossei*.

N. gossei is another of the species much favoured by aborigines for use as a chewing tobacco. (Latz, 1974).

Selected specimens (total seen about 152)

NORTHERN TERRITORY: *A.C. Beaglehole* 44974, N'Dahla Gorge, 3.vi.1974 (Beaglehole Herbarium); *G.W. Carr* 1521, Ormiston Gorge, 9.vi.1974 (Beaglehole Herbarium); 2136, Gosse Bluff, 26.vi.1974 (Beaglehole Herbarium); *P.K. Latz s.n.*, Ellery Gorge, 11.ii.1967 (NT); 355, Kings Canyon, 12.xii.1968 (AD, MEL, NT); 778, Serpentine Gorge, 7.ix.1970 (NT); 786, Palm Valley, 28.ix.1970 (NT); 818, Maggie Springs, Ayers Rock, 24.x.1970 (NT); 896, Bloods Range, 42 km N.E. of Docker River Settlement, 29.x.1970 (NT); 1025, Simpsons Gap, 23.xii.1970 (NT); 4215, Longs Range, 28.viii.1973 (CANB, NT); *R. Pullen* 10488, hill of the Blatherskite Range near Stuart Highway, 25.iii.1977 (CANB); *D.E. Symon s.n.*, Mt Conner, 15.vi.1953 (ADW); *W.H. Tietkens s.n.*, Laura Vale, 1889 (AD).

SOUTH AUSTRALIA: *H. Haigh & L.D. Williams* 6435, Everard Range, near Pocket Well, Oct. 1974 (AD); *F.T. Turvey s.n.*, 64 km west of Ernabella, 15.viii.1966 (NSW 85271); *Wallace s.n.*, Musgrave Ranges, 26° 17'S, 131° 01'E, 12.viii.1973 (ADW 50056, NT 53589).

9. *N. megalosiphon* Heurck & Muell.-Arg. in Van Heurck, Obs. Bot. 126 (1870).

Type: "Habitat in Nova-Hollandia septentrionali ad Portum Curtis (hb. van Heurck, collector ignotus probabiliter Damell.)" (Daemel?) *s.dat.* (current locality not determined; no reply received from AWH to query as to possible location there).

Herb to 0.8(-0.9) m high, with 1 or 2 (rarely more) main stems. *Indumentum* on all parts a fairly dense pubescence of glandular trichomes. *Leaves* both radical and cauline or mostly radical; *lamina* (1-) 3-12(-17) cm long x (0.1-) 1-6(-9) cm wide, elliptic to ovate or narrowly so, to lanceolate above, often linear at base of inflorescence; apex obtuse or acute on basal leaves, becoming acute, to acuminate on most distal leaves; margin entire or occasionally slightly sinuate; *petiole* to 7(-9.5) cm long, narrowly winged, insertion on stem simple or slightly stem-clasping. *Inflorescence* an elongate, few-branched panicle, occupying up to $\frac{1}{2}$ ($\frac{2}{3}$) the length of stems; *bracts* (1-) 2-13(-27) mm long, linear to lanceolate; *pedicels* to 24(-30) mm long in fruit. *Calyx* 10-18(-21) mm long; sepals linear-lanceolate, subequal (rarely equal), fused for $(\frac{2}{5})\frac{1}{2}$ ($\frac{3}{5}$) their length; intersepal membranes long but inconspicuous. *Corolla tube* (34-) 40-82(-93) mm long, 1-2(-2.5) mm wide at top of calyx; tube proper not distinct from throat cylinder; throat cup distinct in bud, not very distinct after anthesis, symmetrical or almost so; *corolla limb* (13-) 18-30(-35) mm diameter, closing in sunlight, lobes emarginate (rarely obtuse), fused for $\frac{1}{3}$ their length. Upper 4 *stamens* level or almost so, in throat cup; *filaments* of upper 4 stamens 0.5-2 mm long, of fifth 1.5-11 mm long and inserted onto corolla in distal $\frac{1}{2}$ of tube. *Capsule* 7-12(-16) mm long, shorter than calyx, ovoid-ellipsoid (length:breadth 2:1). *Seeds* 0.6-0.9(-1.0) mm long, reniform or acutely angled.

Notes

Depauperate specimens of this species may be confused with *N. simulans* in that the corolla tube is usually short and approaches that of *N. simulans* in length. Morphologically, these two species appear to be closely related.

Subsp. megalosiphon

Leaves petiolate or rarely the most distal ones sessile; lamina base obtuse or cuneate, often attenuate on most distal leaves. *Seed testa* irregularly honeycombed or usually wrinkled. (Figs. 4a, 10b).

Chromosome number: $n = 20$ (Wheeler, 1935:54).

Distribution and habitat

N. megalosiphon subsp. *megalosiphon* occurs in south-eastern and central Queensland, and in mid-northern to north-eastern New South Wales (Fig. 17), and grows in sandy to loam or clay soils in open areas in savannah or woodland, often in disturbed sites.

Selected specimens (total seen about 250)

QUEENSLAND: *Adams 1367*, 3 km north of Glenlee Station, 13.x.1964 (BRI, CANB, NSW); *S.T. Blake 11652*, Oakley Station, 2.vi.1936 (BRI); *B.G. Briggs 1155*, Forest Park Station, 14.viii.1967 (NSW); 4292, 3 km east of Cracow on Eidsvold road, 2.vi.1971 (NSW); *N.T. Burbidge 5488*, 14 km north of Cunnamulla, 6.ix.1956 (BRI, CANB); 5511, 19 km north of Emmet on Isisford road, 8.ix.1956 (BRI, CANB); 5565, Baffle Creek, 13.ix.1956 (CANB); *I.J. Dale 163*, 125 km N.W. of Clermont, 29.vii.1977 (BRI); *S.L. Everist 3081*, between Bendena and Theodore Tank, 14.vii.1947 (BRI); 3516, 61 km west of Condamine, 12.x.1948 (CANB); 3672, Cashel Vale Station, 28.iv.1949 (BRI); 6115, 19 km north of St George, 12.ix.1959 (BRI); *L. Pedley 764*, Hannaford, 25.iii.1961 (CANB); *R.W. Purdie 103*, 62 km S.E. of Charleville on Boatman road, 23.iii.1976 (BRI); *I. Romano s.n.*, Three Moon Creek, near Monto, Nov. 1974 (BRI 182272); *C.T. White 12228*, Bybera Station, 28.ix.1935 (BRI).

NEW SOUTH WALES: *P.M. Blundell s.n.*, Bingarra, May 1911 (NSW 48739); *E.F. Constable s.n.*, Mount Harris Station, 30.iv.1952 (NSW 20593); *D.F. Thompson 1709*, Tipperary Station, Lightning Ridge, 19.v.1976 (NSW); *J. Thompson 1118*, 14 km from Brewarrina on Tarcoon road, 30.viii.1971 (NSW).

Subsp. sessilifolia P. Horton, subsp. nov.

Type: P.K. Latz 2503, Marshall River, Northern Territory, 19.v.1972 (NT, holo.; ADW; BRI; CANB; NSW).

Folia basi petiolata, caulina pandurata ad sessilia super; basis laminae obtusa vel cuneata, supra auriculata et amplexicaula. Testa seminis favosa (interdum irregulariter).



Fig. 10. (a) *Nicotiana megalosiphon* subsp. *sessilifolia*, voucher *P.K. Latz 2503* (CANB); (b) *N. megalosiphon* subsp. *megalosiphon*, voucher *N.T. Burbidge 5512* (CANB); (c) *N. simulans*, voucher *R.H. Kuchel 607* (AD).

Basal leaves petiolate, the cauline ones soon becoming pandurate to sessile above; lamina base obtuse or cuneate, becoming auriculate and stem-clasping above. Seed testa honeycombed (occasionally irregularly so). (Figs. 4b, 10a).

Chromosome number: not known.

Distribution and habitat

N. megalosiphon subsp. *sessilifolia* occurs across central to southern Northern Territory roughly north of Alice Springs, across to western Queensland (Fig. 17). It grows in sandy, loam or clay soils along creeklines or near water, occasionally in soil traps on rocky hillsides.

Notes

Robust specimens of this subspecies may occasionally be confused with *N. gossei*, but can be distinguished by the reticulate seed ornamentation, non-woolly vestiture, shorter calyx and a number of other characteristics.

Selected specimens (total seen about 123)

NORTHERN TERRITORY: *G. Chippendale s.n.*, Long Hole, 48 km N.W. of Willowra Homestead, 30.vii.1958 (AD 96145139), BRI 32503, MEL, NSW 60701, NT 4754; *J.B. Cleland s.n.*, Mt Palmer, 26.viii.1956 (AD 95929143); *P.K. Latz 643*, old Huckitta Homestead, 20.vii.1970 (NT); 785, Palm Valley, 28.ix.1970 (AD, CANB, MEL, NT); 1032, Serpentine Gorge, 28.xii.1970 (AD, NT); 1059, Elkera No.2 Bore, 5.i.1971 (AD, MEL, NT); 1695, Georgina Downs Homestead, 28.vii.1971 (ADW); 2154, Mount Wedge Station, 20.i.1972 (CANB, NT); 2271, Amburla Station, 5.iv.1972 (AD, CANB, NT); 2500, 5 km S.S.E. of Eastern Chief Bore, 18.v.1972 (AD, ADW, NT); 2549, Toko Hills, Tobermorey Station, 22.v.1972 (ADW, NT); 2571, Field River, 23.v.1972 (ADW, BRI, NSW, NT); 4302, Old Station Well, Mount Riddock Station, 12.ix.1973 (ADW); 4431, Mt Alooarjara, 3.x.1973 (NT); 6971, Davenport Range, 5.v.1977 (ADW, BRI, NT); *H.S. McKee 8570*, Napperby Creek, 22.ii.1961 (NSW); *R. Swinbourne 355*, 6 km north of Alice Springs, 30.vii.1962 (CANB, NSW, NT); 384, ca 24 km N.W. of Aileron Homestead, 2.viii.1962 (CANB, NSW, NT).

QUEENSLAND: *S.L. Everist 3229*, Hyperion block near Quita Creek, Kallala Station, 22.xi.1947 (BRI, CANB); *S. Jacobs 1303*, Leichhardt Falls, 27.iv.1974 (NSW).

10. *N. simulans* N.T. Burbidge, Aust. J. Bot. 8:365, fig. 10, pl. 16 fig. 1 (1960).

Type: *N.T. Burbidge 4625*, ca 40 miles (64 km) from Mount Willoughby towards Mabel Creek, S. Aust., 10.x.1955 (CANB, holo.).

Herb to 0.7(-1.2) m high, with 1-5 or occasionally more stems. *Indumentum* on all parts a dense to moderately sparse pubescence of glandular trichomes. *Leaves* both radical and cauline or mostly radical, petiolate near base of plant, becoming sessile above; *lamina* (1-)2-10(-23) cm long x (0.2-)0.5-5(-12) cm wide, elliptic or occasionally spatulate (rarely broadly so), becoming narrow-ovate or -elliptic above, to lanceolate (rarely linear) at base of inflorescence; apex acute, or occasionally obtuse on basal leaves, to acuminate above; base obtuse to attenuate, often slightly stem-clasping if leaves sessile; margin entire or occasionally sinuate; *petiole* to 5(-9) cm long, narrowly to moderately broadly winged, insertion on stem occasionally simple, usually slightly stem-clasping. *Inflorescence* an elongate, few-branched panicle, occupying up to $\frac{1}{2}$ or occasionally more (sometimes almost all) the length of stems; *bracts* 3-25(-47) mm long, linear-lanceolate to lanceolate, occasionally leafy at base of inflorescence; *pedicels* to 22(-42) mm in fruit. *Calyx* (5-)8-15(-17) mm long; sepals linear to lanceolate, subequal, fused for $\frac{1}{2}$ - $\frac{2}{3}$ their length (rarely more); intersepal membranes long, often conspicuous. *Corolla tube* 22-38(-42) mm long, (1-)1.5-2.5(-3.5) mm wide at top of calyx; tube proper not distinct from throat cylinder; throat cup not very distinct, slightly or strongly asymmetrical; *corolla limb* (6-)10-20(-24) mm diameter, closing in sunlight, lobes emarginate (or very shallowly so to almost obtuse), fused for $\frac{1}{4}$ - $\frac{4}{5}$ their length. Upper 4 *stamens* almost level or usually subdidynamous, in throat cup or the longer pair slightly exserted, fifth stamen between the two of the shorter pair; *filaments* of upper 4 stamens 1-5 mm long, of fifth 2-8 mm long

and inserted onto corolla in distal $\frac{1}{2}$ of tube, or half way down. *Capsule* (5-)8-11(-13) mm long, usually shorter than calyx, occasionally equalling or longer than calyx, ovoid to ellipsoid (length:breadth 2:1). *Seeds* (0.5-)0.7-0.9(-1.1) mm long, reniform or acutely angled; testa honeycombed or irregularly so. (Fig. 10c).

Chromosome number: $n = 20$ (Burbidge, 1960:367).

Distribution and habitat

N. simulans has a widespread distribution extending from near the coast in central Western Australia across through southern Northern Territory (roughly south of Alice Springs) and northern regions of South Australia, to north-western and central New South Wales (with one collection from southern Queensland) (Fig. 17). It grows in sandy or rocky areas, often in the shelter of boulders or trees.

Notes

N. simulans may occasionally be confused with depauperate specimens of *N. megalosiphon* with unusually short flowers, but it can be distinguished from the latter by its subdidynamy of stamens. Cleistogamous flowers are occasionally formed.

Selected specimens (total seen about 304)

WESTERN AUSTRALIA: *T.E.H. Aplin B2*, Boolathana Station, 5.xi.1963 (AD, PERTH); *A.C. Beauglehole 11428*, Weeli Wolli Creek, 13.viii.1965 (Beauglehole Herbarium); *N.T. Burbidge 6031*, 66 km south of Roy Hill towards Mundiwindi, 8.v.1958 (AD, CANB); *A.S. George 3837b*, Mt Eveline 22.viii.1962 (PERTH); *D.E. Symon 9914*, 10 km north of Broad Arrow, 11.v.1975 (ADW, PERTH).

NORTHERN TERRITORY: *G. Chippendale s.n.*, Kalamurta Dam, 7.vii.1955 (NSW 48697, NT 1364); *P.K. Latz 5081*, Mulga Park Station, 29.iv.1974 (ADW, MEL, NT); 6803, Andado Station, 15.iv.1977 (AD, ADW, NSW, NT).

QUEENSLAND: *L. Pedley 2441*, near Paroo River ca 32 km N.N.E. of Eulo, 8.ix.1967 (BRI).

NEW SOUTH WALES: *G.M. Cunningham 847*, 13 km west of Nyngan on Cobar road, 24.v.1969 (NSW); *C.W.E. Moore 4832*, Tundulya Station, 18.iv.1967 (CANB); *L.R. Richley 107*, Fowlers Gap, 20.ix.1973 (AD); 1385, St Helena Paddock, Purnanga Station, 17.ii.1974 (NSW).

SOUTH AUSTRALIA: *A.C. Beauglehole 25632*, Everard Ranges, Mt Illbillee area, 27.vi.1968 (Beauglehole Herbarium); *P. Horton 199*, The Margaret River, ca 14 km S.E. of Coward Springs Siding, 6.x.1978 (ADW); *B. Lay 252*, Leaks Bore, Bon Bon Station, 5.v.1971 (AD); *T.R.N. Lothian 812*, Ant Bore, De Rose Hill Station, July 1954 (AD); *R.D. Pearce 135*, 6 km from Paralana Hot Springs on Arkaroola road, 2.x.1978 (ADW); *D.E. Symon 11468*, Arckaringa Hills, 21.x.1978 (ADW).

11. *N. rosulata* (S. Moore) Domin, Biblioth. Bot. 89:1146, pl.36 fig.11 (1929).

Type: *S. Moore s.n.*, West Australian Goldfields, bank of creek near Wilsons Pool, Western Aust., April 1895 (BM-photo. in ADW, lecto., here proposed; K-photo. in ADW).

N. suaveolens var. *rosulata* S. Moore, J. Linn. Soc. 34:206 (1898), basionym.

N. stenocarpa Wheeler, Univ. Calif. Publ. Bot. 18:61 (1935).

Type: *J.H. Maiden s.n.*, Laverton, Western Aust., Sept. 1909 (NSW, holo.).

Herb to 0.8(-1) m high, with one or a few leafless or sparsely-leaved stems, occasionally somewhat woody at the base. *Indumentum* on bracts, pedicels and calyx a sparse to fairly dense covering of glandular trichomes. *Leaves* petiolate or if cauline leaves present then occasionally the distal-most sub-sessile; *lamina* (1-)3-15(-21) cm long x (0.1-)1-7(-11.5) cm wide, elliptic or occasionally ovate or spatulate, or narrowly so, becoming narrower to lanceolate or linear above; apex obtuse to acute, acuminate on distal leaves; base attenuate; margin entire or slightly sinuate; *petiole* (0-)1-5(-8) cm long, narrowly winged, insertion onto stem simple. *Inflorescence* an elongate, few-branched panicle, occupying distal $\frac{1}{2}$ ($\frac{2}{3}$, rarely more) the length of stems; *bracts* 2-11(-30) mm long, linear to lanceolate; *pedicels* to 20(-36) mm long in fruit. *Sepals* linear to linear-lanceolate (rarely lanceolate), equal to unequal, fused for $\frac{1}{2}$ - $\frac{2}{3}$ ($\frac{3}{4}$) their length; intersepal membranes

long but fairly inconspicuous. *Corolla tube* 1-2 mm wide at top of calyx; tube proper not distinct from throat cylinder; throat cup not very distinct or indistinct, almost symmetrical to distinctly asymmetrical; *corolla limb* 7-25 mm diameter, closing in sunlight, lobes emarginate, fused for $\frac{2}{3}$ - $\frac{4}{5}$ their length. *Filaments* of upper 4 stamens 1-3.5 mm long, of fifth 4.5-18 mm long, inserted onto corolla in distal $\frac{1}{2}$ of tube. *Capsule* (6-)-7-16 mm long, ellipsoid or narrowly so (length: breadth 2:1 to 3:1 [-7:2]). *Seeds* 0.7-1.1 mm long; testa with irregular honeycombs to short round-edged wrinkles.

Notes

Moore (1898) did not specify a particular specimen as the holotype of *N. suaveolens* var. *rosulata* (nor did Domin (1929) for *N. rosulata*) and since the type collection has been split a lectotype should be chosen. The BM specimen (which Burbidge (1960) quoted as the holotype) is here nominated as the lectotype.

Cleistogamous flowers are occasionally formed in this species. In addition, the corolla tube of *N. rosulata* subsp. *rosulata* exhibits considerable variation in length, similar to that found in *N. occidentalis* subsp. *obliqua*, and is usually either short (less than 22 mm) or long (more than 25 mm) with occasional specimens intermediate in length. As with *N. occidentalis* subsp. *obliqua* there appears to be no correlation between tube length and habitat (as indicated on herbarium labels) or physical state of the plant, but in general the short-flowered specimens occur in the more south-western part and the long-flowered in the more north-eastern part of the range of *N. rosulata* subsp. *rosulata*. Thus a cline of corolla tube length occurs over the range of *N. rosulata*, the tube being very long in the north-east (subsp. *ingulba*) and becoming progressively shorter to the south-west (subsp. *rosulata*).

Subsp. *rosulata*

Leaves and proximal parts of stems pubescent or sparsely so with elongate eglandular trichomes; stems soon becoming glabrous more distally. *Leaves* all or mostly radical. *Calyx* (6-)-8-15 mm long. *Corolla tube* (15-)-17-37(-45) mm long. Upper 4 *stamens* almost level to subdidynamous, if subdidynamous then the fifth between the two of the shorter pair. *Capsule* equalling calyx or slightly shorter or longer. *Seeds* reniform or acutely angled, angle occasionally less than 45°. (Fig. 11a).

Chromosome number: $n = 20$ (Burbidge, 1960:348).

Distribution and habitat

N. rosulata subsp. *rosulata* occurs across central Western Australia and extends into western South Australia (Fig. 18); it grows mostly in sandy soils, occasionally stony, often along creeklines under trees.

Selected specimens (total seen about 100)

WESTERN AUSTRALIA: T.E.H. Aplin 2364, 5 km north of Agnew, 18.viii.1963 (MEL, PERTH); A.M. Ashby 3566b, Canning Stock Route between Weld Spring and Pierre Spring, Aug. 1970 (AD); J.S. Beard 2642, 8 km north of Paynes Find, 10.viii.1963 (PERTH); A.C. Beaglehole 60123, 171 km S.W. of Warburton Mission on Laverton road, 18.ix.1978 (Beaglehole Herbarium); N.T. Burbidge 1225, Pardoo, 24.vii.1941 (PERTH); C.A. Gardner 2319, Meekatharra, 16.vii.1931 (PERTH); A.S. George 811, ca 19 km west of Mount Magnet, 17.iv.1960 (PERTH); 3730, 6 miles east of Leonora, 18.viii.1962 (PERTH); L. Haegi 1105, ca 5 km N.N.E. of Wongan Hills on Dalwallinu road, 23.ix.1976 (AD); R.D. Royce 1977, 32 km south of Jiggalong, 8.vi.1947 (PERTH); T.L. Setter 363, Gascoyne River 3 km south of Mt Deverell, 17.ix.1973 (ADW); D.E. Symon 2472, Glen Cumming, near Giles, Rawlinson Range, 2.viii.1962 (AD, ADW).

SOUTH AUSTRALIA: R.B. Major 50, ca 80 km S.W. of Mt Sir Thomas, 1966 (AD); D.E. Symon s.n., cultivated, 16.xi.1965, from seed collected at Mt Christie (ADW); D.J.E. Whibley 1117, Wild Cat Bore, ca 25 km S.W. of Everard Park Homestead, 13.ix.1963 (AD, MEL).



Fig. 11. (a) *Nicotiana rosulata* subsp. *rosulata*, voucher A.S. George 4471 (PERTH); (b) *N. rosulata* subsp. *ingulba*, voucher M. Lazarides 8352 (NT); (c) *N. goodspeedii*, voucher H. Turner s.n. (AD 96221272).

Subsp. *ingulba* (J.M. Black) P. Horton, comb. nov.

Type: *E. Kramer s.n.*, Harpers Springs, Northern Territory, *s.dat.* (AD, holo.).

N. ingulba J.M. Black, Trans. R. Soc. S. Aust. 57:156, pl.9 fig.1 (1933), basionym.

Leaves and stems glabrous, or occasionally sparse, elongate, eglandular trichomes present at base of plant. *Leaves* mostly radical with a few cauline; cauline leaves rarely absent, occasionally numerous. *Calyx* (8-)10-17(-22) mm long. *Corolla tube* (19-)30-56(-64) mm long. Upper 4 *stamens* subdidynamous, the fifth between the two of the shorter pair. *Capsule* usually shorter than calyx, rarely equalling or longer than calyx. *Seeds* reniform or acutely angled, angle often less than 45°. (Fig. 11b).

Chromosome number: $n = 20$ (Burbidge, 1960:348).

Distribution and habitat

This subspecies occurs in southern Northern Territory and in western Western Australia near the Northern Territory-South Australia border, where it overlaps the range of subsp. *rosulata*. In addition, a few collections of subsp. *ingulba* have been made from south-eastern Western Australia, somewhat removed from the major part of its range (Fig. 18). It grows in sand, usually in the shelter of trees.

Notes

There are no features which consistently distinguish between the two subspecies of *N. rosulata*. The combined characteristics of corolla tube length and presence or absence of pubescence near the base of the plant are generally satisfactory for their separation. However, one or both characters may often be intermediate between the two usual states (particularly in the range of overlap of the two subspecies), and when both are intermediate it is not possible to determine the specimen with confidence as one subspecies or the other. For these reasons *N. ingulba* was reduced to a subspecies of *N. rosulata*, the latter being the earlier published name.

N. rosulata subsp. *ingulba* was one of the native tobaccos often used by aborigines as a chewing tobacco (Latz, 1974).

Selected specimens (total seen about 145)

WESTERN AUSTRALIA: *W.H. Butler s.n.*, Lake Nyanga, Jan. 1962 (PERTH); *A.S. George 6016*, 3 km west of Zanthus, 11.xi.1963 (PERTH); 8773, 53 km S.E. of Giles Meteorological Station, 19.vii.1967 (MEL, NT, PERTH).

NORTHERN TERRITORY: *N.T. Burbidge 4373*, ca 35 km south of Alice Springs on railway line road, 29.ix.1955 (AD, CANB); *R.C. Carolin 5253*, ca 24 km S.W. of Mt Currie, 18.viii.1966 (NSW, SYD); *G. Chippendale s.n.*, 11 km S.E. of Maryvale Homestead, 3.ix.1956 (AD 96145138, CANB 98166, MEL *s.n.*, NSW 60704, NT 2767); *s.n.*, 19 km N.W. of Harper Springs Homestead, 12.viii.1959 (AD 95952128, BRI 22389, NSW *s.n.*, NT 6462); *P.K. Latz 1699*, Arganara Creek, 28.vii.1971 (BRI, CANB, NT); *M. Lazarides 6060*, 27 km south of Mount Wedge Station, 19.ix.1956 (AD, BRI, CANB, NSW, NT); 8352, ca 111 km S.E. of Docker River Mission on Ayers Rock road, 11.v.1977 (CANB, NT); *D.J. Nelson 415*, 17 km north of Aileron, 2.viii.1962 (AD, CANB, NT); *R.A. Perry 3417*, 19 km N.N.E. of MacDonald Downs Station, 12.iii.1953 (BRI, CANB, NT); 5338, 42 km north of Barrow Creek, 2.ix.1955 (AD, CANB, MEL, NSW, NT); *D.E. Symon 10385*, 13 km north of Hugh River crossing on Erldunda road, 11.vi.1975 (ADW, NT).

12. *N. goodspeedii* Wheeler, Univ. Calif. Publ. Bot. 18:63 (1935).

Type: *Mrs Richards s.n.*, Fowlers Bay, S. Aust., 1879 (MEL *s.n.*, holo.).

Herb to 0.7(-1.0) m high, with several (up to 10 or occasionally more) leafless or sparsely-leaved stems. *Indumentum* on bracts, pedicels and calyx a fairly dense covering of glandular trichomes; leaves and stems glabrous, or occasionally sparsely-scattered eglandular trichomes present on young growth. *Leaves* mostly radical, petiolate or the uppermost cauline leaves subsessile to sessile; *lamina* (0.5-)1-11(-19) cm long x (0.1-)0.5-3.5(-5.5) cm wide, elliptic to spatulate or narrowly so, to narrow elliptic above; apex

obtuse, acute or acuminate (narrower in cauline than in radical leaves); base attenuate; margin entire or slightly sinuate; *petiole* to 5(-8) cm long, narrowly winged, insertion onto stem simple. *Inflorescence* an elongate, few-branched panicle, occupying up to distal $\frac{1}{2}$ to $\frac{2}{3}$ (rarely more) the length of stems; *bracts* 1-5(-10) mm long, linear to lanceolate or narrow-elliptic; *pedicels* to 20(-29) mm long in fruit. *Calyx* 4-10(-12) mm long; sepals lanceolate to linear-lanceolate, equal to unequal, fused for $\frac{1}{2}$ to $\frac{3}{4}$ ($-\frac{4}{5}$) their length; intersepal membranes long but fairly inconspicuous. *Corolla tube* (8-) 10-19 mm long, 1-3(-3.5) mm wide at top of calyx; tube proper slightly narrower than throat cylinder; throat cup not very distinct, symmetrical; *corolla limb* (5-) 6-12 mm diameter, closing in sunlight, lobes obtuse to emarginate, fused for $\frac{1}{2}$ - $\frac{2}{3}$ their length. Upper 4 *stamens* level or almost so, in throat cup; *filaments* of upper 4 stamens 0.5-4.5 mm long, of fifth (4-) 5-9.5 mm long and inserted onto corolla in proximal $\frac{1}{2}$ of tube. *Capsule* 5-10 mm long, equalling calyx or occasionally slightly shorter or longer, ellipsoid or ovoid-ellipsoid (length:breadth 2:1 or occasionally 5:2 or 3:2). *Seeds* 0.5-1.0 mm long, C-shaped; testa with short, round-edged wrinkles. (Fig. 11c).

Chromosome number: $n = 20$ (Wheeler, 1935:63).

Distribution and habitat

N. goodspeedii extends from south-eastern Western Australia across the Nullarbor Plain, around the head of Spencers and St Vincents Gulfs and along the Murray River and the plains to its north, into south-western New South Wales (Fig. 18). It grows mostly in open areas, often disturbed, such as caves, dams, water courses, cliffs, sand-dunes and roadsides, and usually in alkaline soils, often sand over limestone.

Selected specimens (total seen about 227)

WESTERN AUSTRALIA: *T.E.H. Aplin* 1715, Mundrabilla Station, 4.ix.1962 (PERTH); *D.W. Goodall* 2460, 5 km east of Breakaway Dam, Koonjarra, 1.xii.1965 (PERTH); *R.S. Vickery s.n.*, Neebubbe Cave, ca 24 km W.N.W. of Eucla, 5.i.1957 (AD 96413011); *P.G. Wilson* 7650, Kanandah Station, 3.ix.1968 (PERTH).

NEW SOUTH WALES: *G.M. Cunningham & P.L. Milthorpe* 4316, Booberoi Regeneration Area, Booberoi Railway Siding, 17.iii.1976 (NSW).

VICTORIA: *A.H. Corrick* 8, Middle Marsh, ca 24 km west of Kerong, 17.ii.1974 (MEL).

SOUTH AUSTRALIA: *B.J. Blaylock* 2077, ca 7 km S.S.W. of Scrubby Peak, 8.ix.1972 (AD); *R.J. Chinnock* 1184, 15 km east of Koonalda Homestead, 20.ix.1973 (AD); *P.J. Cole* 11, near Saltia, Pichi Richi Pass, 18.v.1967 (AD); *L. Haegi* 621, ca 6 km S.S.W. of Koonamore Homestead, 30.iii.1975 (ADW); *P. Horton* 202, dam, ca 8.5 km S.E. of Ketchowla Homestead, 17.vi.1979 (ADW); *A.E. Orchard* 3193, ca 5 km N.E. of Yalata Swamp Well, 6.i.1971 (AD); *R.D. Pearce* 123, 6.4 km from Tickera on road to Wallaroo, 21.v.1978 (ADW); *R.A. Perry* 5567, 24 km north of Maralinga, 26.i.1956 (CANB); *M.E. Phillips s.n.*, 58 km from Iron Knob, towards Port Augusta, 3.ix.1962 (AD 96830139); *D.E. Symon s.n.*, near Inila Rock, 30.ix.1959 (ADW 21254); 3870, Murray River front at Overland Corner, 12.x.1965 (ADW, CANB); 8815, 17.7 km north of Two Wells, 17.v.1974 (ADW).

13. *N. suaveolens* Lehm., Gen. Nicot. 43 (1818) (n.v.).

Type: "*N. undulata* ex Hortus Malmaison, Herbar de Ventenat", cultivated from seeds sent from England by M. le Chevalier Banks, originally from Port Jackson, New South Wales, *s.dat.* (G-photo. in ADW, holo.).

N. undulata Vent., Jard. Malm. 1, tab. 10 (1804), nom. illeg., non R. & P.

N. suaveolens var. *undulata* (Vent.) Comes, Monogr. Nicot.: 40 (1899).

N. exigua Wheeler, Univ. Calif. Publ. Bot. 18: 64 (1935) (see Notes).

Type: cultivated plant, 31424 P6, grown at University of California Botanic Gardens 1932 from seed accession 1931-59 collected *J.H. McCarthy s.n.*, Dalby, Qld, *s.dat.* (UC, holo., n.v.; AD).

Herb to 0.8(-1.5) m high, with one or a few stems, occasionally woody at the base. *Indumentum* of bracts, pedicels and calyx a fairly sparse to dense covering of glandular trichomes; stems and leaves glabrous, or basal leaves, stem bases and young growth sparsely to fairly densely covered with eglandular trichomes, often elongate and occasionally light-woolly. *Leaves* both radical and cauline, rarely mostly or all radical,

petiolate; *lamina* (2-)4-16(-31)cm long x (0.3-)1-8(-19.5)cm wide, ovate or elliptic or narrowly so, becoming narrower above to lanceolate to linear; apex obtuse or acute, becoming narrower above to acute to acuminate; base cuneate or attenuate, occasionally obtuse, to attenuate above; margin entire to sinuate or occasionally undulate; *petiole* to 7 (-16)cm long, narrowly or occasionally moderately broadly winged, insertion onto stem simple or slightly stem-clasping. *Inflorescence* an elongate, few-branched panicle, or occasionally several-branched, occupying up to $\frac{2}{5}$ (- $\frac{1}{2}$) the length of stems; *bracts* 1-13 mm long, linear to lanceolate; *pedicels* to 20(-25)mm long in fruit. *Calyx* (6-)8-13 (-26) mm long; sepals linear to lanceolate, equal or subequal, fused for $\frac{1}{2}$ - $\frac{3}{5}$ (- $\frac{2}{3}$) their length; intersepal membranes long and usually fairly conspicuous. *Corolla tube* (17-)22-40(-55)mm long, (1.5-)2-4(-6)mm wide at top of calyx; tube proper distinctly narrower than throat cylinder; throat cup indistinct, symmetrical; *corolla limb* 14-25 (-37) mm diameter, closing in sunlight, lobes emarginate or obtuse, fused for $\frac{1}{3}$ - $\frac{1}{2}$ their length. Upper 4 *stamens* level or almost so, in throat cup or slightly exserted; *filaments* of upper 4 stamens 1-3 mm long, of fifth 11-16 mm long and inserted onto corolla in proximal $\frac{1}{2}$ of tube. *Capsule* 7-12 mm long, shorter than or equalling calyx (rarely longer than calyx), ovoid or ovoid-ellipsoid (length:breadth 2:1 to 3:2). *Seeds* 0.7-1.0(-1.2)mm long, reniform or acutely angled, angle occasionally $<45^\circ$, testa irregularly honeycombed to wrinkled (Fig. 12a).

Chromosome number: $n = 16$ (Wheeler, 1935:58). Wheeler also described two tetraploid strains ($n=32$) grown at the University of California Botanic Gardens.

Distribution and habitat

N. suaveolens is distributed through eastern and southern New South Wales, and in scattered areas of Victoria (Fig. 19). It grows in sandy to stony soils on creek banks or rocky slopes or in the understorey of woodland or scrub.

Notes

The type specimens of *N. exigua* have the appearance of small-flowered *N. suaveolens*, with which they share the same chromosome number ($n=16$, Wheeler, 1935), but the type locality is considerably further north than the northernmost part of the range of *N. suaveolens*. *N. exigua* is therefore tentatively placed in synonymy under *N. suaveolens*. Wheeler (1935) assigned no specimens to *N. exigua* other than the type specimens. Of the specimens which Burbidge (1960) identified as *N. exigua*, most have C-shaped seeds (unlike the type specimens which have seeds resembling those of *N. suaveolens*) and are almost certainly *N. velutina* (to which I have referred them) although with unusually glabrescent stems. The remainder appear to be *N. suaveolens*. Burbidge (1960) believed *N. exigua* to be closely related to and possibly conspecific with *N. goodspeedii*. This is almost certainly a result of her identification of specimens with C-shaped seeds (a character shared by *N. velutina* and *N. goodspeedii* but not by *N. exigua*) as *N. exigua*. With their C-shaped seeds and often glabrescent stems, they superficially resemble *N. goodspeedii*, which in contrast has glabrous stems.

Selected specimens (total seen about 188)

NEW SOUTH WALES: *N.T. Burbidge* 6421, Yenda to Rankins Springs Stock Route, N.W. of Yenda, 30.vii.1959 (AD, BRI, CANB, MEL, NSW); *E.F. Constable s.n.*, Abercrombie Caves, 22.iii.1955 (NSW 31207); *J. Corbin s.n.*, 24km north of Griffith, 24.x.1962 (CANB 118021, NSW 141413); *A.B. Costin s.n.*, Tin Hut, near Jacobs River, 6.xi.1948 (NSW 48764); *S.L. Everist* S23, 30.5km S.S.E. of Coonamble on Gilgandra Road, 7.xii.1969 (BRI); *L. Haegi* 1355, 2km south of Coopers Bridge over Lachlan River on Hillston Road, 7.ix.1977 (AD); *S. Jacobs* 2353, Bar Island, Hawkesbury River, 22.vi.1975 (NSW); *L.A.S. Johnson s.n.*, ca 16km north of Tooraweenah on Coonamble road, 16.iv.1952 (NSW 20568); *P. Martensz* 173, Bundure Station, 23.v.1969 (CANB, NSW); *R. Pullen* 4173A, Bungonia Gorge, 10.xi.1966 (CANB); *A. Rodd* 412, Culoul Range, 5.ii.1967 (NSW).

VICTORIA: *A.C. Beauglehole* 40432, Timberoo Forest Reserve, 21.ix.1972 (MEL); *T. Henshall s.n.*, Dargo High Plains, Jan. 1966 (NT 46052); *R. Melville* 3150, Cape Schanck, Mornington Peninsula, 8.ii.1953 (AD, BRI, MEL, NSW); *T.B. Muir* 2845, Maribyrnong River at Bulla, 18.v.1963 (MEL); *K.C. Rogers s.n.*, The



Fig. 12. (a) *Nicotiana suaveolens*, voucher A.V. Hill & C.J. Shepherd s.n. (CANB 125987); (b) *N. maritima*, voucher J.Z. Weber 3908 (AD); (c) *N. velutina*, voucher P. Horton 191 (ADW).

Pyramids, Murrindal River, ca 16 km north of Buchan, 10.i.1962 (MEL); *C.J. Shepherd & M. Gray* 5632, Running Creek, Deddick to Tubbut Road, 30.x.1964 (BRI, MEL, NSW); *J.H. Willis s.n.*, Rileys Creek gorge, ca 2 km upstream from road crossing at Staughton Vale, 20.x.1955 (MEL); *s.n.*, at Snowy River crossing of Vic.-N.S.W. border, 22.ii.1962 (CANB 242565, MEL).

14. *N. maritima* Wheeler, Univ. Calif. Publ. Bot. 18:56 (1935).

Type: *J.B. Cleland s.n.*, Hallett's Cove, Sth Aust., Sept. 1932 (UC, n.v., holo.; AD 97615147).

Herb to 0.7 (-1) m high, with 1 or a few (up to 4 or 5) stems occasionally tinged bluish, often woody at the base in older plants. *Indumentum* of leaves and stems a sparse to dense pubescence of eglandular trichomes, usually conspicuously white- or grey-woolly at base of stems; stems usually glabrescent; bracts, pedicels and calyx with moderately sparse to dense glandular trichomes. *Leaves* mostly radical, petiolate or the distal-most subsessile to sessile; *lamina* (1-)2-13 (-22) cm long x (0.1-) 0.5-7 (-14) cm wide, ovate or elliptic, occasionally widely so or spatulate, narrower above to narrow elliptic or lanceolate, occasionally linear, at base of inflorescence; apex obtuse or acute, to acuminate on distal leaves; base narrow cuneate or attenuate; margin sinuate or occasionally undulate, rarely entire; *petiole* to 6.5 (-9) cm long, broadly (occasionally fairly narrowly), winged, insertion onto stem simple or slightly stem-clasping. *Inflorescence* an elongate, few-branched panicle or occasionally several-branched, occupying up to $\frac{1}{2}$ (- $\frac{2}{3}$) the length of stems; *bracts* 2-12 (-25) mm long, linear to lanceolate; *pedicels* to 21 (-30) mm long in fruit. *Calyx* 6-12 (-16) mm long; sepals linear-lanceolate to lanceolate, subequal, fused for $\frac{1}{3}$ - $\frac{2}{3}$ their length (rarely more); intersepal membranes long, often fairly conspicuous. *Corolla tube* 13-25 (-30) mm long, (1.5-)2-5 mm wide at top of calyx; tube proper distinctly narrower than throat cylinder, throat cup indistinct, symmetrical or almost so; *corolla limb* 7.5-20 (-24) mm diameter, closing in sunlight, lobes obtuse or usually emarginate, fused for $(\frac{1}{4})$ - $\frac{1}{3}$ - $\frac{1}{2}$ (- $\frac{2}{3}$) their length. Upper 4 *stamens* level or almost so, in throat cup; *filaments* of upper 4 *stamens* 0.5-4 mm long, of fifth 6-11.5 mm long and inserted onto corolla in proximal $\frac{1}{2}$ of tube. *Capsule* (4.5-)6-11 (-12) mm long, equalling or slightly shorter than calyx, occasionally slightly longer, ellipsoid to ovoid-ellipsoid or widely so (length: breadth 2:1 to 3:2, rarely 1:1). *Seeds* 0.6-1.1 mm long, reniform or acutely angled, occasionally oblong or L-shaped; testa irregularly honeycombed to wrinkled (Figs. 4f, 12b).

Chromosome number: $n = 16$ (Wheeler, 1935:57).

Distribution and habitat

N. maritima occurs principally in coastal regions of South Australia, on Eyre, York and Fleurieu Peninsulas, and also on offshore islands including Kangaroo Island (Fig. 19). A few old collections indicate that its range extends, or at least once extended, into Victoria: *J.P. Eckert s.n.*, Wimmera, 1891 (MEL 85766) and *Anonymous s.n.*, Grampians, *s.dat.* (MEL s.n.). This species usually grows in rocky areas in sand or gravelly soil or amongst rocks, often on the coastline or along creek-banks near the coast (but may also grow further inland).

Notes

N. maritima appears to be closely related morphologically to *N. suaveolens* and *N. velutina*, with which it shares the same chromosome number ($n=16$). In effect *N. maritima* replaces *N. suaveolens* at the western margin of the latter's range and continues the sweep of these two species across south-eastern Australia. It is, however, more closely associated with coastal regions than is *N. suaveolens*.

Selected specimens (total seen about 148)

SOUTH AUSTRALIA: *C.R. Alcock* 2633, Big Swamp, Flinders Highway, 4.ii.1969 (AD, ADW, CANB); *B.J. Blaylock* 1240, Peella Rock, 26.iv.1969 (AD); *B. Copley* 1626, Yarraroo Station via Kulpura, 5.xi.1967

(AD); *Hj. Eichler* 19452, ca 11 km north of Elliston on Streaky Bay road, 12.x.1967 (AD); *P. Horton* 203, east side of Marble Range, west of Marble Range Homestead, 28.ix.1979 (ADW); *D.N. Kraehenbuehl* 2672, Sellicks Beach scrub, 3.xi.1968 (AD); *P.K. Latz* 134, Waterfall Gully, Adelaide, 24.ix.1967 (NT); *T.R.N. Lothian* 1130, Wool Bay, 7.x.1962 (AD); *R. Schodde* 1051, Strangway Waterfalls ca 15 km N.W. of Victor Harbor, 28.xii.1958 (AD, CANB); *T. Smith* 452, Whittons Bluff, Port Noarlunga, 27.ix.1967 (AD); *A.G. Spooner* 3588, Kinchina, 21.ix.1974 (AD); *D.E. Symon* 6613, Dorothea Island, Investigator Group, 10.i.1969 (AD, ADW, CANB); 8855, just west of Walkers Flat, 7.ix.1974 (ADW); 8927, west end of Carrappee Hill, 15.ix.1974 (ADW); 10563, Second Valley, 28.i.1976 (ADW); *J.R. Wheeler* 790, western slopes of the Blue Range, Hincks National Park, 7.x.1968 (AD); *L.D. Williams* 578, Woods Well to Culburra Road, 6.xii.1959 (AD); *P.G. Wilson* 480, Minnipa Hill, 15.x.1958 (AD).

15. *N. velutina* Wheeler, Univ. Calif. Publ. Bot. 18:55 (1935).

Type: *A. Morris s.n.*, Broken Hill, N.S.W., 4.x.1920 (NSW, holo.).

N. suaveolens var. *debneyi* F.M. Bail., Queensl. Fl. 4:1096 (1901), *nom. nud.*, based on *G.L. Debney s.n.*, Monkira Station, Diamantina River, Qld, Aug. 1891 (BRI 14168).

Herb to 0.8(-1.5) m high, with a few (up to 6[-10]) stems. *Indumentum* on all parts a sparse to dense covering of eglandular and glandular trichomes; stems occasionally glabrescent. *Leaves* both radical and cauline or mostly radical, petiolate or the distal-most subsessile to sessile; *lamina* (1-) 2-15(-28) cm long x (0.2-) 0.5-7(-12) cm wide, elliptic (rarely spatulate) or narrowly so, becoming narrower to lanceolate or linear above; apex obtuse or acute, to acuminate on distal leaves; base attenuate or occasionally cuneate or narrowly so; margin entire to sinuate, rarely undulate; *petiole* to 9(-15) cm long, narrowly or occasionally moderately broadly winged, insertion onto stem simple or occasionally slightly stem-clasping. *Inflorescence* an elongate, few-branched panicle, or occasionally several-branched, occupying up to $\frac{2}{3}$ (rarely almost all) the length of stems; *bracts* 2-12(-15) mm long, lanceolate to linear-lanceolate; *pedicels* to 29(-35) mm long in fruit. *Calyx* (5-) 7.5-13(-17) mm long; sepals lanceolate to linear-lanceolate, subequal (rarely unequal), fused for ($\frac{2}{5}$ -) $\frac{1}{2}$ - $\frac{2}{3}$ (- $\frac{3}{4}$) their length; intersepal membranes usually fairly indistinct, occasionally conspicuous. *Corolla tube* (11-) 13-27(-35) mm long, (1-) 1.5-3.5(-4.5) mm wide at top of calyx; tube proper distinctly narrower than throat cylinder; throat cup usually indistinct, symmetrical or almost so; *corolla limb* 7-24(-30) mm diameter, closing in sunlight, lobes obtuse to emarginate, fused for ($\frac{1}{4}$ -) $\frac{1}{3}$ - $\frac{3}{4}$ their length. Upper 4 *stamens* level or almost so, in throat cup; *filaments* of upper 4 stamens 0.3-3.5 mm long, of fifth 5-10 mm long and inserted onto corolla in proximal $\frac{1}{2}$ of tube. *Capsule* (5-) 7-11 mm long, slightly shorter than or equalling calyx, occasionally slightly longer, ellipsoid to ovoid-ellipsoid (length:breadth 2:1, occasionally 5:2, rarely 3:2). *Seeds* 0.5-1.0 mm long, C-shaped or occasionally angled (<45°), or occasionally angled (>45°) or strongly reniform; testa with round-edged wrinkles or occasionally irregularly honeycombed. (Figs. 4e, 12c).

Chromosome number: $n = 16$ (Wheeler, 1935:56).

Distribution and habitat

N. velutina occurs across southern Northern Territory, most of South Australia, southern Queensland (except near the coast), central and western New South Wales, and in north-western Victoria (Fig. 19). This common species grows almost exclusively in sandy areas, often on the dunes surrounding salt lakes.

Notes

Despite the presence of apparently suitable habitat in eastern Western Australia, no convincing collections of *N. velutina* from this region were seen. Three Western Australian collections from near the Northern Territory-South Australia border (*D.E. Symon* 2175, 2339, and 2445) resemble *N. velutina*, but the seeds are mostly not C-shaped and are similar to those of *N. rotundifolia*. They are probably simply aberrant specimens of *N. velutina*.

N. velutina is typically fairly densely pubescent on all parts, but occasional specimens occur with glabrescent stems, particularly in the Murray River region of eastern South Australia and along the eastern margin of the species' range in Queensland. Many specimens from the latter area were referred to *N. exigua* by Burbidge (1960; see notes under *N. suaveolens*, in which I have included *N. exigua*), but they can be distinguished from *N. suaveolens* by their C-shaped seeds.

Two species morphologically closely related to *N. velutina* are *N. maritima* and *N. suaveolens*; a close relationship is further indicated by their chromosome numbers, all $n = 16$. *N. velutina* represents the most inland and arid-adapted species of the group, and occupies the sand sheets to the north and west of the ranges of *N. maritima* and *N. suaveolens*.

Selected specimens (total seen about 894)

NORTHERN TERRITORY: *G. Chippendale s.n.*, Temple Bar Creek, 17 km S.W. of Alice Springs, 27.ix.1958 (AD 96145156, BRI 32504, CANB 98164, MEL, NSW 60702, NT 4968); *P.K. Latz 689*, 43 km S.S.W. of The Granites, 30.vii.1970 (CANB, NT); *M. Lazarides 6087*, 48 km S.S.W. of Napperby Station, 28.ix.1956 (AD, CANB, MEL, NT); *D.J. Nelson 59*, Sandover River, 5 km north of Utopia homestead, 7.x.1961 (CANB, MEL, NSW, NT).

QUEENSLAND: *S.T. Blake 10647*, Noondoo, 2.iii.1936 (BRI); *11184*, Cunnamulla, 12.iv.1936 (BRI); *D.E. Boyland 276*, Poeppel Corner, 24.ix.1960 (BRI, CANB); *S.L. Everist 5603*, Belmont Station, 11.ix.1956 (BRI, CANB).

NEW SOUTH WALES: *N.T. Burbidge 6625*, Lake Tandou, 22.vii.1960 (CANB, NSW); *6643*, 77 km north of Wentworth, 23.vii.1960 (NSW, CANB); *J. Pickard 2357*, 6 km S.E. of Pincally Homestead, 23.vii.1973 (NSW); *3058*, 11 km S.W. of Moalie Park Homestead on road to Salisbury Downs Station, 29.x.1976 (NSW).

VICTORIA: *A.C. Beauglehole 56124*, Lake Powell, 3.v.1977 (MEL).

SOUTH AUSTRALIA: *N. Forde 510*, 15 km west of Emu, 8.ix.1956 (AD, CANB, MEL, NSW); *P. Horton 200*, Hamilton Hill, 6.x.1978 (ADW); *M. Lazarides 8388*, Strzelecki Track, 45 km north of Moomba Gas Field, 18.v.1977 (AD, CANB, NSW); *R.D. Pearce 138*, Nooldoonooldoona Waterhole, 3.x.1978 (ADW); *R. Schodde 473*, ca 4 km south of De Rose Hill Station, 4.ix.1957 (AD, CANB); *D.E. Symon 8027*, between Lake View Dam and shores of Lake Frome, 17.ix.1972 (ADW).

16. *N. rotundifolia* Lindley, Bot. Reg. 24: misc. 59 (1838).

Type: cultivated plants? from seeds received by R. Mangles from "the neighbourhood of Swan River", W. Aust., *s.dat.* (not located).

N. fastigiata Nees in Lehm., Pl. Preiss. 1:343 (1845).

Type: *Preiss 1911*, "in solo humoso ad caput fluvii Cygnorum", 14.i.1840 (LD, holo.? No duplicates held at HBG, L or S. A sheet held at MEL bears the number 1911 but no further collection details; it may be a *Preiss* collection. Burbidge (1960) quotes a duplicate of *Preiss 1911* as being held at MEL).

N. neesii Lehm. ex Nees in Lehm., Pl. Preiss. 1:344 (1845).

Type: *Preiss 1912*, "in rupestribus umbrosis ad latus occidentale montis Brown, York", 4.ix.1839 (LD, holo.? No duplicates held at HBG, L or S).

N. suaveolens var. *rotundifolia* (Lindley) Comes, Monogr. Nicot.: 42 (1899).

N. rotundifolia Lindley subsp. *aridicola* N.T. Burbidge, Aust. J. Bot. 8:370, pl. 5 fig. 2, pl. 6 fig. 2, pl. 17 fig. 2 (1960).

Type: *N.T. Burbidge 2668*, Pioneer Rock, north of Lake Cowan, W. Aust., 19.ix.1947 (CANB, holo.).

Herb to 0.6(-0.9)m high, with 1-3 or occasionally more stems. *Indumentum* on all parts a sparse to dense pubescence of eglandular and glandular trichomes, often elongate; stems occasionally glabrescent. *Leaves* mostly or all radical or occasionally cauline leaves numerous, petiolate or occasionally the distal-most subsessile (rarely sessile); *lamina* (0.7-)1.5-11.5(-25)cm long x (0.2-)0.7-6(-16)cm wide, elliptic or occasionally narrowly or broadly so, becoming narrow-elliptic (occasionally narrow-ovate) above, to lanceolate to linear at base of inflorescence; apex obtuse or acute, to acuminate on distal leaves; base cuneate or attenuate, occasionally obtuse; margin entire to sinuate; *petiole* to 7(-14)cm long, narrowly winged, insertion onto stem simple, rarely slightly stem-clasping. *Inflorescence* an elongate, few-branched panicle,

occupying up to $\frac{1}{2}$ the length of stems; *bracts* (1-)2-15(-20) mm long, linear to lanceolate; *pedicels* to 23(-46) mm long in fruit. *Calyx* (5-)6-9(-13) mm long; sepals linear-lanceolate (rarely lanceolate), equal or subequal, fused for $(\frac{2}{5}-)\frac{1}{2}-\frac{3}{5}$ their length; intersepal membranes long and usually conspicuous. *Corolla tube* 13-18 mm long, 1-2.5(-3) mm wide at top of calyx; tube proper narrower than throat cylinder or occasionally almost the same width; throat cup moderately or not very distinct, symmetrical; *corolla limb* 5-10 (-16) mm diameter, closing in sunlight, lobes emarginate and often deeply so, fused for $\frac{2}{5}-\frac{2}{3}$ their length. Upper 4 *stamens* level or usually slightly subdidynamous, in throat cup, fifth between the two of the shorter pair; *filaments* of upper 4 stamens 0.5-1.3 mm long, of fifth 4.5-8 mm long and inserted onto corolla in proximal $\frac{1}{2}$ of tube. *Capsule* (4-)5-8 (-9) mm long, shorter than or occasionally equalling calyx, ovoid or ovoid-ellipsoid (length:breadth 2:1, occasionally 3:2). *Seeds* 0.6-0.9(-1.1) mm long, reniform or acutely angled; testa with irregular honeycombs to short round-edged wrinkles. (Fig. 13a).

Chromosome number: $n = 22$ (Burbidge, 1960:370).

Distribution and habitat

N. rotundifolia occurs in south-western Western Australia (Fig. 19), in diverse habitats from granite outcrops to sandy watercourses, generally in the shelter of boulders or trees.

Notes

In the more western regions of the range of *N. rotundifolia* there is a trend towards increased leafiness of stems and a more honeycombed seed ornamentation (rather than serpentine). Thus eastern specimens often correspond with Burbidge's *N. rotundifolia* subsp. *aridicola* in having mostly radical leaves and seeds with serpentine ornamentation, and western specimens often correspond with subsp. *rotundifolia* (sensu Burbidge, 1960), with stems leafy below the inflorescence and seed coats irregularly honeycombed. However, the pattern of variation of either character is not always consistent. Furthermore, numerous specimens occur in which one or both characters are intermediate between their states in these two subspecies, and others in which one character is in the state found in one subspecies and the other character in that of the other subspecies. Burbidge (1960) considered that the shape of the calyx lobes differs between these two subspecies (lanceolate-acuminate in subsp. *rotundifolia* and linear or linear-subulate in subsp. *aridicola*), but I could find no such difference. For these reasons, and because the proportion of radical and cauline leaves is somewhat variable in most other Australian *Nicotiana*, and a certain degree of variation often occurs in seed ornamentation in other species, no formal taxa are recognized in *N. rotundifolia*.

Selected specimens (total seen about 99)

WESTERN AUSTRALIA: *T.E.H. Aplin* 1757, 150 km east of Norseman, 5.ix.1962 (ADW, PERTH); 2577, 18 km south of Nanambinia Station, 23.x.1963 (PERTH); *E.T. Bailey* 406, Muresk, Sept. 1945 (PERTH); *N.T. Burbidge s.n.*, Badjanning Hill, near Wagin, Dec. 1955 (CANB 188280, NSW 141417); 204, near Trial Mill, Glenorn Station, 19.viii.1938 (PERTH); 4881, 40 km south of Coolgardie on Norseman road, 17.xii.1955 (CANB); *Hj. Eichler* 20174, Lort River near crossing of the Esperance to Ravensthorpe road, 11.x.1968 (AD, PERTH); *C.A. Gardner s.n.*, Nalyaring Well, 2.viii.1939 (PERTH); *A.S. George s.n.*, Canning River between Maddington and Gosnells, 16.ii.1965 (PERTH); 7363, Tuttanning Reserve, 17.xi.1965 (PERTH); *L. Haegi* 1151, ca 2 km east of Kalbarri on Binnu road, 26.ix.1976 (AD, BRI); *R. Melville* 4225, 34 km east of Pindar, 20.vii.1953 (AD, MEL, NSW, PERTH); *R.A. Rose* 128, Bromus, July 1963 (PERTH); *R.D. Royce* 4425, Comet Vale, 23.ix.1953 (PERTH); 9700, Watheroo National Park, 7.x.1971 (PERTH).

17. *N. glauca* Graham, Bot. Mag. 55, tab. 2837 (1828); Edinb. New Phil. Jour. 5:175 (1828)(n.v.).

Type: cultivated 1828 at Royal Botanic Garden, Edinburgh, from seed "communicated.....by Mr Smith.....whose son had sent them from Buenos Ayres." (E, holo.).

Erect, often spindly, tree-like shrub to 6 m high, with 1 or a few main woody stems; stems often tinged bluish. *Indumentum* a few eglandular trichomes on new growth, bracts, pedicels and calyx; other parts glabrous. *Leaves* rubbery, glaucous, petiolate; *lamina* (1-)2-13(-23)cm long x (0.5-)1-7(-17)cm wide, ovate or elliptic, occasionally narrowly or widely so (rarely obovate); apex obtuse to broad-acuminate; base obtuse to cuneate or narrow-cuneate; margin entire or slightly sinuate; *petiole* (0.5-)1-6(-12)cm long, terete, or narrowly winged near base of lamina, insertion onto stem simple.

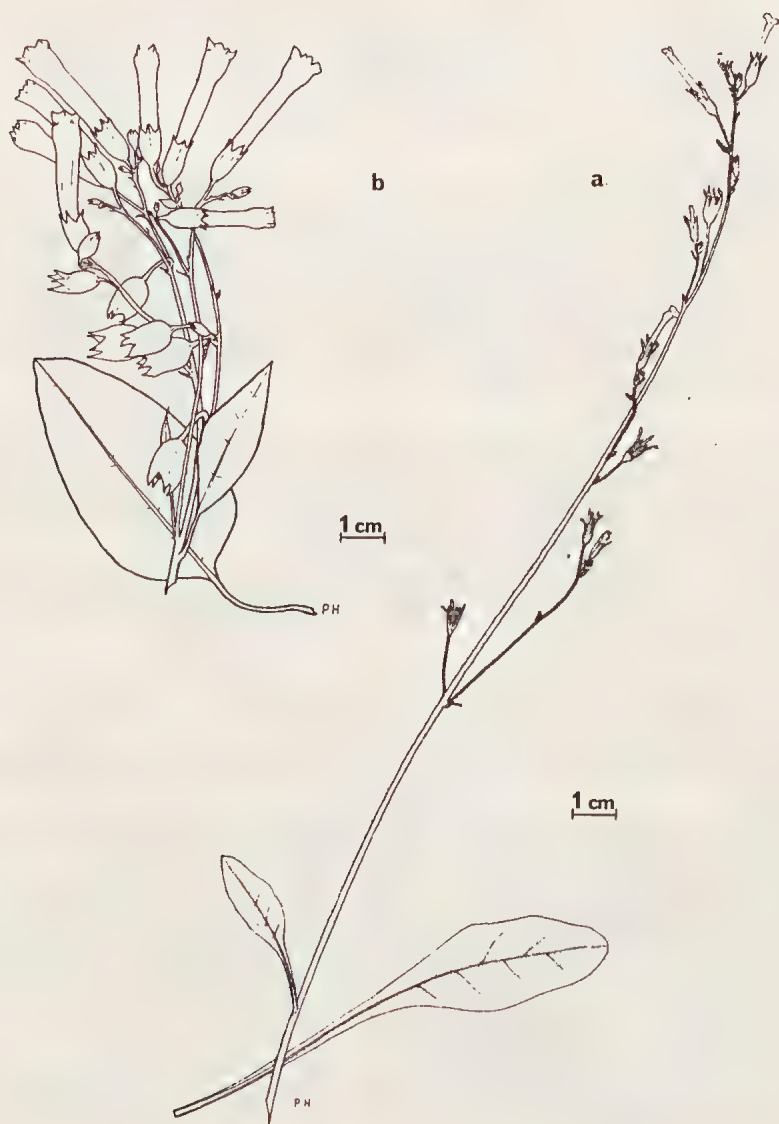


Fig. 13. (a) *Nicotiana rotundifolia*, voucher Hj. Eichler 20174 (PERTH); (b) *N. glauca*, voucher D.E. Symon 7294 (ADW).

Inflorescence a short, dense, terminal panicle; *bracts* 2-7(-18) mm long, lanceolate to linear-lanceolate; *pedicels* to 15 mm long and curved or reflexed in fruit. *Calyx* 7-14 (-17) mm long; sepals narrow-elliptic or elliptic-lanceolate, equal to subequal, fused for $\frac{2}{3}$ - $\frac{7}{8}$ their length; intersepal membranes inconspicuous. *Corolla* yellow or yellowish; *corolla tube* (19-) 21-40 mm long, (2.5-3.5(-6.5) mm wide at top of calyx; tube proper fairly distinctly narrower than throat cylinder; throat cup not very distinct, symmetrical; *corolla limb* 8-13 mm diameter, remaining open in sunlight, lobes obtuse, fused for $\frac{2}{3}$ to almost all their length. *Stamens* all level or nearly so, their anthers near top of throat cup; *filaments* 19-29 mm long, all inserted onto corolla in proximal $\frac{1}{2}$ of tube. *Capsule* 7-13 mm long, equalling or slightly shorter than calyx, ellipsoid to ovoid-ellipsoid or widely so, occasionally suborbicular (length:breadth 3:2, occasionally 1:1, rarely 2:1). *Seeds* 0.5-0.9 mm long, reniform to triangular- or oblong-reniform; testa honeycombed or with elongate honeycombs or wrinkles. (Fig. 13b).

Chromosome number: $n = 12$ (Goodspeed, 1954:336).

Distribution and habitat

N. glauca is considered to be a native of Argentina but has become widespread in many warm temperate regions of the world, including Australia. In Australia it occurs throughout south-eastern Queensland, most of New South Wales and Victoria, in Northern Territory south of Alice Springs, south-eastern and central South Australia, and in Western Australia around Perth and Geraldton and scattered in southern regions (Fig. 15). It grows in open and disturbed areas including creeklines, roadsides and wasteland, in a wide variety of soil types.

Notes

N. glauca has become well established in widespread regions of Australia, having been introduced at quite an early date. For instance in about 1847 it was apparently brought from Melbourne to Adelaide by Mr F.M. Dutton and "one box given to Bailey's Hackney Nursery" (J. Bureau Agric., 6:160 [1893]).

In Australia, *N. glauca* may flower at any time throughout the year. Occasional hybrids have apparently occurred between some endemic species and *N. glauca* (see section on hybrids).

Selected specimens (total seen about 329)

WESTERN AUSTRALIA: T.E.H. Aplin 1490, 34 km south of Geraldton, 23.v.1962 (PERTH); L. Haegi 918, base of Mt Charlotte, Kalgoorlie, N.E. side, 12.ix.1976 (AD).

NORTHERN TERRITORY: S.A. Parker 169, Finke River, 3 km west of Horseshoe Bend Homestead, 2.v.1970 (NT).

QUEENSLAND: L. Durrington 511, Serpentine Creek and environs, ca 11 km N.E. of Brisbane, Dec. 1972 (BRI); J. Ebersohn 259, Wittenburra Station, 39 km south of Eulo, 9.x.1962 (BRI); N.H. Speck 2009, 14 km north of Wowan, 17.v.1964 (BRI, CANB).

NEW SOUTH WALES: S. Jacobs 1923, Sandstone Paddock, Fowlers Gap, 18.x.1974 (NSW); E.J. McBarron 3071, stock route, Henty, 15.ii.1949 (NSW); J.C. deNardi 1025, ca 35 km N.W. of Euston, 16.x.1972 (NSW); J. Pickard 3138, Depot Glen, 12 km north of Milparinka, 30.x.1976 (NSW); A. Rodd 1883, 18 km south of Bourke on Cobar Road, 4.xi.1971 (NSW); K.L. Wilson 1612, Marlow, 22 km north of Conoble Railway Station, 23.x.1976 (NSW).

VICTORIA: H.I. Aston 545, Lake Bael Bael, 9.ii.1960 (MEL); E.M. Canning 2985, 8 km from Jeparit, towards Nhill, 11.xi.1969 (ADW, MEL).

SOUTH AUSTRALIA: D.E. Symon 8333, Lake Acraman, 3.x.1972 (ADW); 11448, Andamooka, 22.x.1978 (ADW); J.R. Wheeler 444, Chowilla Station, 17.ix.1967 (AD); D.J.E. Whibley 5477, Mt Mambray, 9.i.1975 (AD); L.D. Williams 1596, Meningie, 19.i.1962 (AD); P.G. Wilson 1689, 1 km N.W. of Cook, 16.ix.1960 (AD).



Fig. 14. Distribution of *Nicotiana* in Australia.

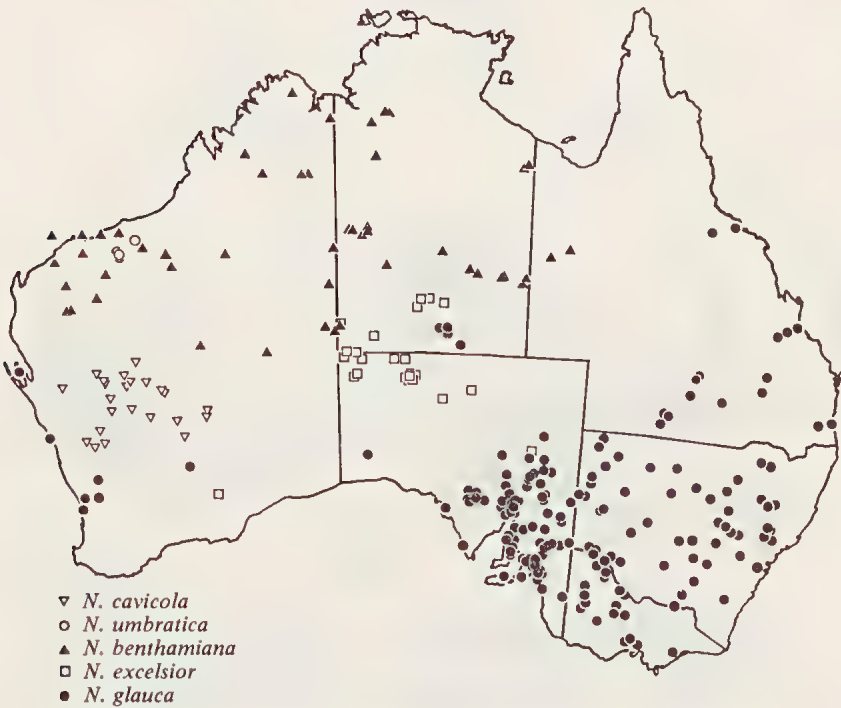


Fig. 15. Distribution of *Nicotiana* in Australia.

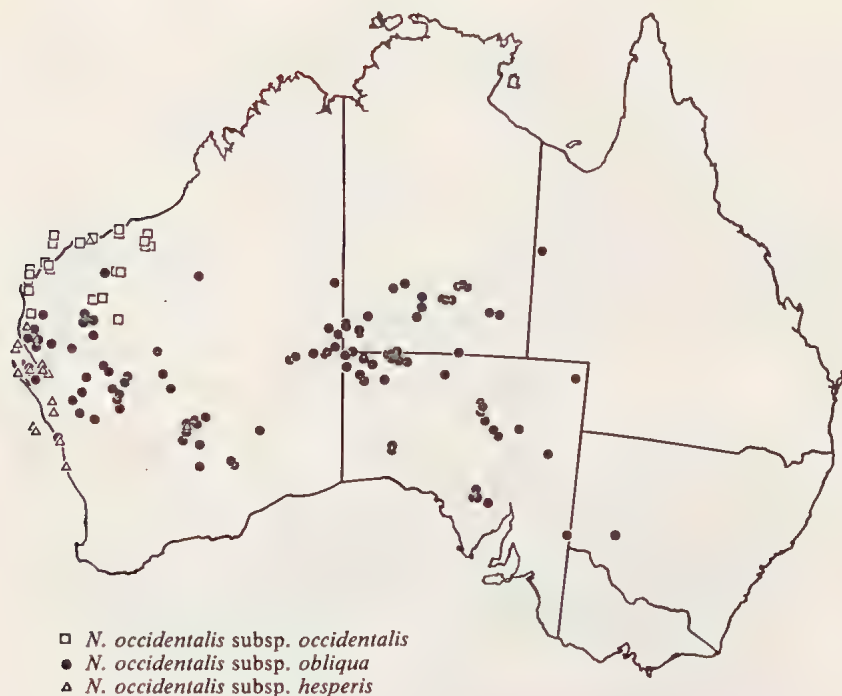


Fig. 16. Distribution of *Nicotiana* in Australia.

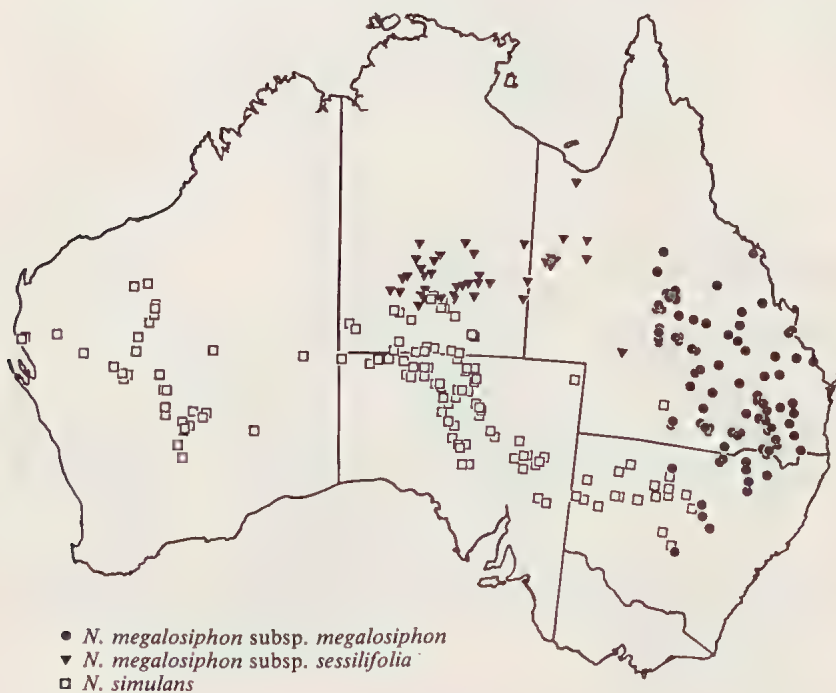


Fig. 17. Distribution of *Nicotiana* in Australia.

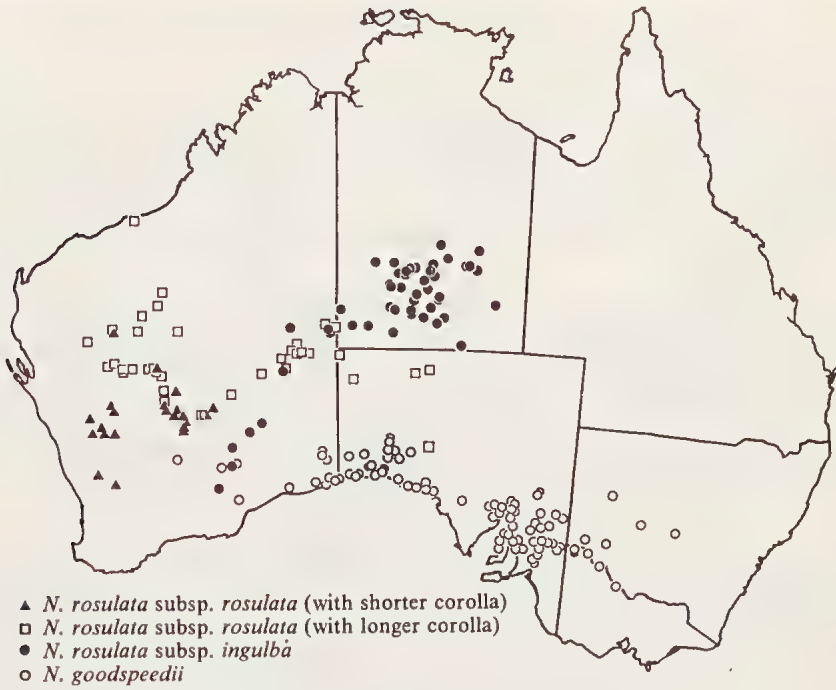


Fig. 18. Distribution of *Nicotiana* in Australia.

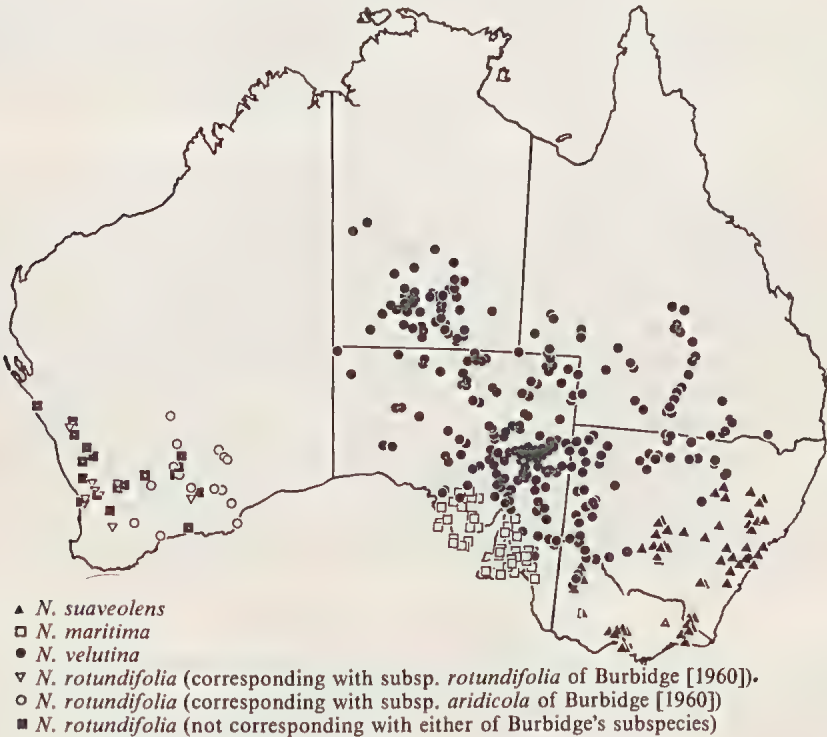


Fig. 19. Distribution of *Nicotiana* in Australia.

Alien species cultivated in Australia

N. tabacum L., Sp. Pl. 1:180 (1753).

Leafy, viscid annual or short-lived perennial about 1-3 m high. *Leaves* almost all cauline, petiolate (uppermost sub-petiolate), elliptic or ovate to lanceolate; *petiole* winged, somewhat auriculate and decurrent down stem. *Inflorescence* a fairly short, dense panicle. *Corolla* whitish to pink; tube (30-)35-55 mm long; tube proper shorter and distinctly narrower than throat cylinder; throat cup distinct; *corolla lobes* acute to acuminate. *Filaments* of upper 4 stamens long, that of fifth slightly shorter, all inserted at base of throat cylinder.

N. tabacum is the major species in commercial tobacco production, in Australia as well as elsewhere. Almost no collections have been noted of this species which were definitely naturalized, so it appears that *N. tabacum* has hardly moved beyond cultivation in Australia. A collection of an apparently spontaneous plant is: *K. L. Wilson* 638, Royal Botanic Gardens, Sydney, New South Wales, 25.x.1974, "On site cleared for new succulent garden" (NSW) (apparently *N. tabacum* does occur sparingly as a weed in most parts of the gardens; L. Haegi, pers. comm. 1980). Another is: *R. V. Southcott s.n.*, Phillip St, Sydney, New South Wales, 18.iii.1960, "On vacant land" (AD 966071444).

N. alata Link & Otto, Ic. Pl. Rar. Hort. Reg. Bot. Berol. 1:63, tab. 32 (1828).

Leafy, viscid, short-lived perennial herb about 1-1.5 m high. *Leaves* mostly cauline, basal ones petiolate, those above becoming sessile and decurrent down stem, elliptic or ovate, uppermost lanceolate; *petiole* winged, stem-clasping or decurrent. *Inflorescence* racemose. *Corolla* white, tinged greenish outside, and at least in cultivation the limb may be purplish-pink; *tube* 50-100 mm long; tube proper longer than and not very distinct from throat cylinder; throat cup fairly distinct; *corolla lobes* acute. *Filaments* of upper 4 stamens fairly long, that of fifth slightly shorter, all inserted at base of throat cylinder.

This South American species is widely grown in cultivation as an ornamental plant. In Australia it does not appear to have extended beyond cultivation; I have seen no field collections of it from Australia.

N. sylvestris Spegazzini & Comes in Comes, Monogr. Nicot.:34 (1899).

Leafy, viscid perennial herb about 1-2 m high. *Leaves* both radical and cauline, basal leaves petiolate, upper ones subsessile to sessile, elliptic, upper ones elliptic to ovate; base auriculate on sessile leaves; *petiole* winged, stem-clasping. *Inflorescence* a short, dense panicle. *Corolla* white, *tube* spindle-shaped, 65-85 mm long; tube proper shorter than and not very distinct from throat cylinder; throat cup indistinct; *corolla lobes* acute or acuminate. *Filaments* of upper 4 stamens long, that of fifth slightly shorter, all inserted at base of throat cylinder.

Although no Australian field collections of *N. sylvestris* (an Argentinian species) were seen, it is at least grown as an ornamental garden plant. Three such garden collections were noted:

H. C. D. Barker s.n., Kadina, S. Aust., March 1978 (AD 97817173); *J. Chraska s.n.*, West Hobart, Tas., *s.dat.* (HO 30551); *D. E. Symon* 10975, American River, Kangaroo Island, 24.i.1978 (ADW).

Names insufficiently known

N. anisandra Vest, Flora 4:147 (1821) (no collection data given; Goodspeed (1954) suggested it may be synonymous with *N. suaveolens*).

N. australasiae R.Br. in Tuckey, Narr. Exped. R. Zaire, etc. app. 5:472 (1818), *nom. nud.*, a synonym of *N. suaveolens* according to Domin (1929) and Goodspeed (1954).

N. australis R.Br. in Comes, Monogr. Nicot.:41 (1899), *nom. nud.* Domin (1929) cites a specimen under this name (for which he gives no description): *Victorian Exploring Expedition s.n.*, Duroodoo, *s.dat.* (K *s.n.*-photo. in ADW), which in fact appears to be *N. velutina*.

N. mirabiliflora Dietr. in Comes, Monogr. Nicot.: 39 (1899), *nom. nud.*? I can find no earlier reference to this name than in Comes (1899), who treats it as a synonym of *N. suaveolens*.

N. odorata hort. ex Donn, Hortus Cantabrig. (1819) (n.v.; not listed in the 1845 edition. Goodspeed (1954) quoted it as originating from Australia and suggested it might be synonymous with *N. suaveolens*).

N. suaveolens var. *anisandra* (Vest) Comes, Monogr. Nicot.: 42 (1899).

N. suaveolens var. *longiflora* Benth., Fl. Austral. 4:470 (1868), a synonym of *N. megalosiphon* according to Domin (1929) and Goodspeed (1954). Bentham described it as "Corolla-tube at least 2in. long. Leaves various.—In the interior of Queensland and N.S.Wales." so it is unlikely to be anything other than *N. megalosiphon*. No type specimen of this variety was cited, and none at K is annotated.

N. suaveolens var. *parviflora* Benth., Fl. Austral. 4:470 (1868). No type specimen was cited, and none at K is annotated.

N. suaveolens var. *vincaeflora* (Lag. ex Link) Comes, Monogr. Nicot.:42 (1899). Comes suggested that it may have originated "from New Holland".

N. vincaeflora Lag. ex Link, Enum. Hort. Berol. 1:179 (1821). Goodspeed (1954) suggested this may be a synonym of *N. suaveolens* or *N. plumbaginifolia* Viviani, the latter a South American species.

Excluded names

N. obtusisepala Domin, Biblioth. Bot. 89:1147, pl.36 fig.1 (1929).

Type: Domin 8324, Hughenden, Qld, Feb. 1910 (PR-photo. in ADW). This appears to be a *Petunia*; Goodspeed (1954) considered it to be *P. axillaris* (Lam.) B.S.P.

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Index to Collections

amp	= <i>N. amplexicaulis</i>	megs	= <i>N. megalosiphon</i> subsp. <i>sessilifolia</i>
ben	= <i>N. benthamiana</i>	occ	= <i>N. occidentalis</i>
cav	= <i>N. cavicola</i>	occh	= <i>N. occidentalis</i> subsp. <i>hesperis</i>
deb	= <i>N. debneyi</i>	occob	= <i>N. occidentalis</i> subsp. <i>obliqua</i>
debd	= <i>N. debneyi</i> subsp. <i>debneyi</i>	occoc	= <i>N. occidentalis</i> subsp. <i>occidentalis</i>
debm	= <i>N. debneyi</i> subsp. <i>monoschizocarpa</i>	ros	= <i>N. rosulata</i>
exc	= <i>N. excelsior</i>	rosi	= <i>N. rosulata</i> subsp. <i>ingulba</i>
gl	= <i>N. glauca</i>	rosr	= <i>N. rosulata</i> subsp. <i>rosulata</i>
good	= <i>N. goodspeedii</i>	rot	= <i>N. rotundifolia</i>
gos	= <i>N. gossei</i>	sim	= <i>N. simulans</i>
mar	= <i>N. maritima</i>	suav	= <i>N. suaveolens</i>
meg	= <i>N. megalosiphon</i>	umb	= <i>N. umbratica</i>
megm	= <i>N. megalosiphon</i> subsp. <i>megalosiphon</i>	vel	= <i>N. velutina</i>

In each case the collector's name is given, followed by the collector's number and then the species collected (abbreviations for which see above). If a collection has no collector's number, then the date of collection is given. Collections are separated by semi-colons, and collectors by dashes. "T" denotes a type collection.

L. Abrahams s.n., ix.1910/vel—Adams 1367/megm—C. Adams 15/megm; 31/megm—P. Aitken s.n., 10.xii.1964/vel—C.R. Alcock 922/mar; 986/mar; 1095/mar; 2633/mar; 3582/vel; 4099/gl; 4219/vel—C.E.F. Allen 630/gos—G.H. Allen 281/vel; 678/gl—G.O. Allen s.n., v. 1923/gl—Amstberg s.n., 4.ix.1969/vel—G.W. Anderson s.n., 23.x.1969/vel—H.G. Andrewartha s.n., 27.iv.1938/sim—Mrs Andrewartha s.n., v.1938/vel—B.G. Andrews 8/sim—C. Andrews s.n., xi.1901/rot; s.n., x.1903/rot—C.R. Andrews 1221/rot—E.C. Andrews s.n., xii.1917/gl—J.C. Anway 471/gl—T.E.H. Aplin s.n., 2.ix.1962/good; B2/sim; 1490/gl; 1694/good; 1715/good; 1757/rot; 2296/occh; 2334a/rosr; 2364/rosr; 2381/rosr; 2456/rosr; 2485/sim; 2499/sim; 2528/cav; 2532/occob; 2577/rot; 3201/occh; 3207/occh; 3295/occob; 3327/gl—Aquinas College Expedition M8/occh—J.M. Arthur s.n., 5.x.1949/debd—A.M. Ashby 2242/occob & sim; 2614/cav; 2943/occoc; 3312/rosr; 3566a/occob & ros; 3566b/rosr; 3992/ben—D. Ashton s.n., viii-ix.1961/vel—H.I. Aston 545/gl.

E.T. Bailey 406/rot—J.F. Bailey s.n., 25.xi.1896/vel; s.n., xii.1896/gl—K.C. Baker 860/megm; 905/megm—J. Baldwin Spencer s.n., ix.1903/sim—S. Barker 15/good; 60/gl—S. Barker & T. Fatchen 21/sim—W.R. Barker 7/gl; 11/good; 360/gl; 391/vel; 2078/ben; 2680/megs; 2681/megs; 3001/occob; 3023/exc; 3118/occob; 3200/vel; 3271/occob; 3371/rosr; 3372/sim; 3470/sim; 3471/occob; 3489/sim; 3512/vel; 3539/sim—R.S. Barnes s.n., 21.viii.1972/vel—W. Barton s.n., 1867/megm—H. Basedow s.n., vii.1926/sim; 211/occob; 350/occob;

390/occob—J.D. Batt s.n., 1889/good; s.n., 1886/good—N.C. Beadle s.n., ix.1939/good; s.n., 2.ii.1946/gl; s.n., viii.1948/gl; s.n., viii.1955/gl—J.S. Beard 2642/rosr; 2876/occob; 6085/occob—A.C. Beauglehole 1065/gl; 2075/vel; 2085/mar; 3603/debd; 7473/vel; 8834/gl; 9845/gl; 10137/exc; 10179/exc; 10256/vel; 10272/vel; 10275/gos; 10288/vel; 10317/vel; 10323/vel; 10534/vel; 11348/ben; 11381/occ; 11428/sim; 11525/occoc; 11567/occoc; 11741/occh; 13146/rot; 13394/good; 13421/good; 20016/vel; 20092/sim; 20281/ros; 20282/gos; 20283/rosi; 20456/rosi; 20602/occob & vel; 20838/vel; 22884/gos; 22937/exc; 23039/ros; 23049/gos; 23259/rosi; 23268/gos; 23269/vel; 23434/vel; 23435/ros; 23436/gos; 23437/rosi; 23731/vel; 23860/gos; 24241/occob; 24426/megs; 25480/exc; 25632/sim; 25944/sim; 25978/gos; 26302/gos; 26303/sim; 26338/gos; 26563/rosi; 27910/vel; 27958/vel; 28156/gl; 28813/vel; 29152/vel; 29861/gl; 33124/suav; 39878/gl; 40432/suav; 40497/good; 44514/vel; 44532/vel; 44664/megs; 44718/megs; 44719/megs & occob; 44723/vel; 44841/megs; 44851/vel; 44952/gos; 44974/gos; 45020/vel; 49067/occob; 49473/good; 50887/ben; 55637/gl; 55985/good; 56068/gl; 56124/vel; 57931/rosi; 58050/vel; 58083/megs; 59570/rosr; 59571/occob; 59760/rosr; 59766/sim; 59897/sim; 60123/rosr; 60200/occob; 60245/occob; 60268/occob; 60546/ben; 60673/rosi; 60727/ben; 60856/rosi—J.M. Béchervaise s.n., 25.viii.1947/vel; s.n., 10.ix.1947/sim—Beckwith s.n., viii.1915/vel—R. & R. Belcher 32/vel; 82/exc; 286/gl; 287/good—R. Bennett s.n., x.1935/vel—D.M. Benson & J. Pickard 1850/gl—R. Berryman s.n., ii.1960/megm—E. Beythien s.n., 1890/good—E.W. Bick s.n., i.1917/gl—C.W. Birch s.n., 1871/megm; s.n., 1884/megm—E.C. Black s.n., x.1923/vel; s.n., viii.1936/megs; s.n., iii.1937/vel; s.n., 12.x.1938/mar; s.n., iv.1941/good; s.n., x.1947/vel—W.E. Blackall, s.n., ix.1939/rosr; 3813/rot; 4094/rot; 4682/occob—S.T. Blake 7627/megm; 10062/megm; 10561/vel; 10599/vel; 10647/vel; 11173/megm; 11184/vel; 11527/ben; 11651/megm; 11652/megm; 11765/vel; 11964/vel; 12222/vel; 12245/vel; 12315/vel—W.F. Blakely s.n., x.1899/suav; s.n., vii.1928/suav—B.J. Blaylock 1240/mar; 1771/mar; 2077/good; 2090/good—D.F. Blaxell 593/vel—J.V. Blockley 989/ben—P.M. Blundell s.n., v.1911/megm—E.F. Boehm s.n., ix.1942/good; 385/good; 386/good—C.D. Boomsma 45B/exc—J.L. Boorman s.n., ix.1904/suav; s.n., x.1906/sim; s.n., vi.1907/gl; s.n., viii.1908/gl; s.n., x.1909/debd; s.n., ii.1911/suav; s.n., viii.1912/debd; s.n., x.1912/gl & vel; s.n., xii.1918/gl—E.J. Booth s.n., 19.ii.1947/gl; G.A. Borthistle s.n., iii.1919/suav—P. Boswell R21/rot—D.L. Boyland 276/vel; 3085/vel—E. Breakwell s.n., viii.1913/gl—B.G. Briggs 1155/megm; 1231/vel; 2284/suav; 4292/megm; 4629/vel—Brooke s.n., xii.1884/rot; s.n., 1886/good—G.B. Brooks s.n., xi.1917/gl; s.n., 13.xi.1934/debd—R. Brooks s.n., xi.1954/gos—Broome s.n., xi.1940/gl—P. Brough s.n., 24.viii.1939/gl & sim—C. Brown s.n., 16.vii.1958/rosi—E.R. Brown s.n., ii.1897/debd—J.S. Brownes s.n., 1875/mar—R. Brummit s.n., 29.ix.1892/vel—N.T. Burbidge s.n., viii.1930/good; s.n., 28.viii.1946/good; s.n., 18.ix.1955/gos; s.n., xii.1955/rot; 202/occob; 204/rot; 1021/occ; 1048/umb; 1077/occoc; 1191/ben; 1225/rosr; 1251/occ; 1335/rosr; 2622/rot; 2668/rot; 4177/sim; 4201/vel; 4202/vel; 4203/megs; 4242/vel; 4256/vel; 4259/rosi; 4263/vel; 4267/vel; 4272/vel; 4341/rosi; 4369/vel; 4370/megs; 4371/megs; 4373/rosi; 4374/rosi; 4495/occob & sim or meg; 4502/vel; 4508/vel; 4509/vel; 4533/vel; 4561/vel; 4590/sim; 4606/sim; 4625/sim T; 4635/sim; 4652/vel; 4671/good; 4853/occob; 4881/rot; 4989/rot; 4990/rot; 5464/megm; 5467/megm; 5477/megm; 5481/megm; 5482/megm; 5484/megm; 5485/megm; 5486/megm; 5487/vel; 5488/megm; 5489/vel; 5490/vel; 5492/vel; 5494/vel; 5495/vel; 5496/meg; 5498/megm; 5499/vel; 5500/vel; 5501/vel; 5502/megm; 5504/megm; 5505/megm; 5509/megm; 5511/megm; 5512/megm; 5513/megm; 5516/megm; 5518/megm; 5522/megm; 5524/megm; 5525/megm; 5528/megm; 5545/megm; 5548/megm; 5552/megm; 5555/megm; 5556/megm; 5560/amp; 5561/debd; 5562/amp T; 5565/megm; 5566/megm; 5567/megm; 5571/vel; 5572/vel; 5573/vel; 5578/vel; 5579/megm; 5580/megm; 5587/megm; 5588/megm; 5589/megm; 5590/megm; 5820/umb; 5873/umb; 5957/umb; 6031/sim; 6068/sim; 6079/rosr; 6082/sim; 6090/sim; 6421/suav; 6422/suav; 6443/occh; 6445/occh; 6451/occh; 6455/occh; 6461/occh; 6473/occh; 6480/occh; 6485/occh; 6486/occh; 6493/occob; 6494A/occh T; 6494B/occob; 6507/occh; 6519/occh; 6593/sim; 6596/sim; 6598/sim; 6603/sim; 6625/vel; 6635/vel; 6636/vel; 6638/vel; 6642/vel; 6643/vel; 6651/suav; T.S.6/debd; T.S.9/suav; T.S.28/megm; T.S.33/vel; T.S.41/suav; T.S.45/suav; T.S.46/suav; T.S.47/suav; T.S.49/gos; T.S.53/exc; T.S.54/megm; T.S.55/good; T.S.56/debd; T.S.57/megm; T.S.58/megm; T.S.61/megm; T.S.64/exc; T.S.65/exc; T.S.67/megm; T.S.70/vel; T.S.71/gos; T.S.72/exc; T.S.73/exc; T.S.74/gos; T.S.75/rosi; T.S.76/vel; T.S.77/gos; T.S.78/gos; T.S.79/exc; T.S.80/gos; T.S.85/vel; T.S.87/ben; T.S.90/suav; T.S.93/gos; T.S.94/rosi; T.S.95/exc; T.S.96/vel; T.S.98/debd; T.S.99/mar; T.S.100/good; T.S.102/rot; T.S.103/rot; T.S.104/gos; T.S.105/exc; T.S.106/good; T.S.107/mar; T.S.110/megm; T.S.111/amp; T.S.112A/vel; T.S.115/good; T.S.118/gos; T.S.119/debd; T.S.120/debd; T.S.121/debd; T.S.123/rosi; T.S.124/vel; T.S.125/vel; T.S.126/vel; T.S.127/vel; T.S.129/vel; T.S.130/sim & vel; T.S.131/vel; T.S.136/sim; T.S.137/sim; T.S.138/sim; T.S.139/ben; T.S.140/vel; T.S.141/vel; T.S.142/vel; T.S.143/vel; T.S.144/vel; T.S.145/vel; T.S.146/vel; T.S.147/vel; T.S.148/sim & vel; T.S.148A/vel; T.S.149/vel; T.S.150/vel; T.S.151/vel; T.S.152/vel; T.S.154/megs; T.S.155/rosi; T.S.157/megs; T.S.158/megs; T.S.159/megs; T.S.160/occob & sim; T.S.161/sim; T.S.162/sim; T.S.163/sim; T.S.164/sim; T.S.164a/vel; T.S.167/megs; T.S.168/good; T.S.169/rot; T.S.170/sim; T.S.171/sim; T.S.172/sim; T.S.173/cav; T.S.174/rosr; T.S.175/sim; T.S.176/occob; T.S.177/sim; T.S.178/rosr; T.S.179/cav & sim; T.S.179a/cav; T.S.181/occob; T.S.182/sim; T.S.183/rosr & sim; T.S.184/rosr; T.S.185/rosr; T.S.186/sim; T.S.187/sim; T.S.188/sim; T.S.189/rosr; T.S.190/rosr; T.S.191/sim; T.S.192/sim; T.S.193/rot; T.S.194/rot; T.S.195/rot; T.S.196/rot; T.S.196a/rot; T.S.197/rot; T.S.198/occob; T.S.199/rot; T.S.200/cav; T.S.201/cav; T.S.202/cav T; T.S.203/cav; T.S.204/cav; T.S.205/cav; T.S.206/cav; T.S.207/cav; T.S.208/sim; T.S.211/rosr; T.S.213/rosr; T.S.214/sim; T.S.215/cav; T.S.216/sim; T.S.217/rosr; T.S.218/rosr; T.S.219/sim; T.S.221/rosr; T.S.222/good; T.S.231/megm; T.S.232/debd; T.S.233/debd; T.S.234/occ; T.S.235/rot; T.S.236/occob; T.S.237/gos; T.S.238/sim; T.S.239/vel; T.S.240/megm; T.S.241/megm; T.S.242/megm; T.S.243/megm;

T.S.244/megm; T.S.245/megm; T.S.246/megm; T.S.247/megm; T.S.248/megm; T.S.249/megm; T.S.250/vel; T.S.251/vel; T.S.252/vel; T.S.253/vel; T.S.254/vel; T.S.255/vel; T.S.256/vel; T.S.260/vel; T.S.261/vel; T.S.262/megm; T.S.263/megm; T.S.264/megm; T.S.265/megm; T.S.266/megm; T.S.267/megm; T.S.268/megm; T.S.269/megm; T.S.271/megm; T.S.274/vel; T.S.276/gos; T.S.277/sim; T.S.278/vel; T.S.280/vel; T.S.281/megm; T.S.282/vel; T.S.285/megm & vel; T.S.287/debd; T.S.289/cav; T.S.290/occob; T.S.291/occob; T.S.293/suav; T.S.294/rot; T.S.297/vel; T.S.298/umb; T.S.299/ben; T.S.301/umb; T.S.302/umb; T.S.303/umb; T.S.304/umb; T.S.305/umb; T.S.306/sim; T.S.307/sim; T.S.308/rosr; T.S.309/sim; T.S.310/sim; T.S.311/sim; T.S.312/sim; T.S.313/rosr; T.S.314/sim; T.S.315/sim; T.S.316/sim; T.S.318/ben; T.S.319/ben; T.S.320/sim; T.S.321/occob; T.S.322/umb; T.S.324/suav; T.S.326/sim; T.S.337/occh—G. Burkitt s.n., s.dat/megm—R. Butler 19/ben—W.H. Butler s.n., viii.1957/occh; s.n., 20.viii.1960/rosr; s.n., i.1962/rosi; 22/occoc—Bynoe s.n., NW. coast, Australia, s.dat/ben T; s.n., Bezout Island, s.dat/ben—P.M. Byrne s.n., 1887/sim.

R.A. Callen 17/vel—E.M. Canning 2171/gl; 2985/gl—F.S. Carey s.n., viii.1884/occh; s.n., 1884/occ; s.n., 1978/occoc—W.M. Carne s.n., 2.iii.1910/debd; s.n., ii.1913/gl—R.C. Carolin 343/vel; 670/vel; 974/debd; 1952/suav; 3257/occh; 5253/rosi; 5292/occob; 5387/rosi; 6088/rosr; 6123/ben; 6143/ben; 6232/ben; 6290/ben; 7596/occoc; 7742/occoc; 7881/occ—G.W. Carr 1322/gos; 1463/vel; 1511/megs; 1521/gos; 1569/gos; 1821/gos; 1828/sim; 2092/vel; 2106/gos; 2136/gos; 2427/megs & vel; 2901/ben; 2964/ben; 4284/ben; 4292/ben; 4927/ben; 5046/ben—J. Carrick 1799/good; 1893/vel; 2061/vel; 2062/occob; 2362/gl; 2379/occob; 3582/mar; 3804/mar—B.B. Carrodus s.n., s.dat./gl; s.n., ix.1956/vel—A. & D. Carson s.n., iii.1887/megm—H. Carter s.n., 1883/suav—F.L. Cavenagh s.n., ix.1933/gos—P. Cawthorn 59/good—R.O. Chalmers and H.J. de S. Disney s.n., 16.vi.1967/vel—M. Chamberlain s.n., 4.i.1915/gl—L. Chandler s.n., 18.xii.1962/good—D. Chapman s.n., s.dat./ben—E. Cheel s.n., 1.xii.1919/suav; s.n., 24.xi.1929/suav—J.W. Chigwidden s.n., 17.vi.1970/gl—R.J. Chinnock 44/gl; 377/vel; 605/ros; 611/ros; 894/ben; 993/ros; 1027/cav; 1184/good; 1522/vel; 1539/good; 1540/gl; 1548/good—G. Chippendale (all collections s.n., NT herbarium numbers given) NT423/vel; NT545/vel; NT692/rosi; NT723/vel; NT1291/megs; NT1299/vel; NT1304/gl; NT1364/sim; NT1569/rosi; NT1615/vel; NT1768/rosi; NT1799/ben; NT2020/rosi; NT2115/vel; NT2644/vel; NT2652/vel; NT2767/rosi; NT2832/vel; NT3492/vel; NT3589/vel; NT3622/gos; NT3648/vel; NT4550/ben; NT4754/megs; NT4888/vel; NT4968/vel; NT6462/rosi; NT6639/vel; NT7387/vel; NT7407/vel; NT7436/rosi—G. Chippendale & E.F. Constable s.n., 20.v.1951/gl—R.E. Choncellor s.n., 10.viii.1961/vel—P.J. Clark 3/good—G.H. Clarke s.n., 22.ix.1936/good—J.B. Cleland (all collections s.n.) 26.xi.1913/good; 21.i.1927/mar; 11.viii.1929/vel; viii.1930/vel; 26.i.1932/mar; 22.v.1932/mar; viii.1932/exc; 11.viii.1932/occob; 16.viii.1932/gos & rosi; 23.viii.1932/vel; ix.1932/mar T; 1.x.1932/gl; 28.x.1932/mar; 12.xi.1932/mar; 7.vii.1933/sim; 13.viii.1933/gos; 16.viii.1933/exc; 19.viii.1933/occob; 20.x.1933/mar; 30.x.1933/mar; 14.viii.1934/vel; 19.viii.1934/vel; 28.i.1935/suav; 29.v.1935/sim; 1.vi.1935/vel; 18.vi.1935/rosi; 21.ix.1935/mar; 13.i.1936/mar; 30.v.1936/vel; 9.viii.1936/gos, megs & occob; 13.viii.1936/ben; 20.viii.1936/ben; 24.viii.1936/vel; 3.xi.1936/good; 5.xi.1936/good; 26.v.1937/vel; 31.v.1937/vel; 14.viii.1937/vel; 4.ix.1941/vel; 17.xii.1941/mar; 12.ii.1942/good; 19.vii.1943/gl; 1.ix.1944/good; 25.ix.1944/sim; 29.viii.1945/exc; 23.ix.1945/sim; 24.ix.1945/occob; 25.ix.1945/sim; 27.ix.1945/exc & vel; 28.ix.1945/occob; 29.ix.1945/sim; 8.v.1946/good; 6.vi.1946/good; 28.viii.1946/vel; 11.iv.1950/exc; 12.iv.1950/exc; 28.viii.1950/vel; 21.ix.1950/good; 14.viii.1951/sim; 19.viii.1951/rosi; 22.iii.1952/mar; 15.x.1953/mar & good; 17.x.1953/good; 20.x.1953/good; 28.x.1953/mar; 11.xi.1953/mar; 21.xi.1953/mar; 15.vi.1954/vel; 19.vii.1954/good; 16.vii.1954/rosr & vel; 17.viii.1954/exc, occob & vel; 19.viii.1954/occob & sim; 24.viii.1954/occob; 28.viii.1954/gos; 1.ix.1954/exc; 4.x.1954/vel; 6.x.1954/good; 9.x.1954/good; 10.x.1954/occob; 21.iv.1955/vel; 12.xi.1955/good; 15.viii.1956/megs; 26.viii.1956/megs & rosi; 30.viii.1956/vel; 14.ix.1956/good; 16.ix.1956/vel; 21.ix.1956/vel; 13.i.1957/mar; 15.viii.1957/megs & vel; 28.viii.1957/rosi; 30.viii.1957/megs; 1.ix.1957/rosi & vel; 4.ix.1957/rosi; 7.ix.1957/vel; 17.ix.1957/good; 26.v.1958/good; 21.vi.1958/ben; 28.vi.1958/exc; 10.iii.1960/good; 23.vi.1960/occob; 26.vi.1960/occob & rosi; 2.vii.1960/gos; 3.vii.1960/exc; 10.xi.1960/mar; 7.vii.1961/good; 28.ix.1961/vel; 8.iii.1962/good; 26.i.1963/mar; 26.v.1963/sim; 12.xi.1964/vel; 18.ix.1965/mar; 26.viii.1966/vel; 10.ix.1966/mar; 27.iii.1967/mar; 21.ix.1968/good; 28.ix.1968/mar—M.S. Clemens s.n., 26.ix.1945/megm; s.n., April 1946/megm; s.n., Sept. 1946/gl; s.n., 1.xii.1947/debd—F. Clement s.n., 1898/ben & occoc—M.A. Clements s.n., Jan. 1905/suav—C.S. Clydesdale s.n., 10.xi.1933/gl—F.B. Cocks 10/gl—P.J. Cole 11/good—D.M. Collins s.n., 26.xi.1953/gl—M.J. Collins s.n., 1923/gl—J.F. Compton s.n., 5.iv.1968/gl—E. Conabere s.n., Oct. 1974/vel—E.F. Constable (all collections s.n.) 17.iv.1947/debd; 16.ix.1947/gl; 26.v.1949/debd; 30.iv.1952/megm; 9.i.1953/debd; 19.i.1953/debd; 22.iii.1955/suav; 18.vii.1955/gl & vel; 27.vii.1955/vel; 9.iii.1957/suav; 23.x.1963/gl—H.M. Cooper s.n., Aug. 1964/mar—B. Copley 146/good; 221/gl; 289/gl; 1073/good; 1133/good; 1252/mar; 1277/good; 1625/mar; 1856/gl; 2084/mar; 2108/mar; 2441/good; 2576/vel; 2708/good; 2730/vel; 3535/vel; 3957/vel—J. Corbin s.n., 24.x.1962/suav—W.H. Cornish s.n., 1885/vel—G.C. Cornwall 199/exc—A.H. Corrick 8/good—A.B. Costin s.n., 6.xi.1948/suav—R. Coveny 460/vel; 10109/debd—A.R. Crawford s.n., 1885/debd—B.C. Crisp 178/vel; 400/vel—M. Crisp 47/vel; 149/good; 256/vel; 518/gl—R.L. Crocker s.n., 27.v.1939/sim; s.n., 2.vi.1939/vel; 28.vi.1939/vel; s.n., 21.vii.1939/vel; 84/exc—O.E. Cronch s.n., April 1913/vel—Cronin s.n., 1893/rot—C. Crossland s.n., 1884/cav & occ—C. Culvenor 304/vel—B. Cumberland 21/gl—G.M. Cunningham 847/sim; 891/gl; 3381/occoc; 4316/good—F.K. Curtin 270/suav—W.H. Cusack s.n., 1896/ben; s.n., 1898/occob—K. Czornij 3/gl; 115/mar; 993a/occoc; 993b/sim; 1098/vel.

I.J. Dale 163/megm—L.G. Dale 283/gl—Dallachy s.n., Rockingham Bay, s.dat./debd T—B.M. Dalton s.n., 4.i.1943/megm—H.V. Dam 22/sim—D. Davidson 128/megm—S. Davies 1/sim; 2/sim; 3/occob; 4/cav; 5/sim; 6/occob; 7/sim—H. Deane s.n., Aug. 1893/gl—G.L. Debney s.n., Aug. 1891/vel—C.M. Deland s.n., June 1954/vel—H. Demarz 2594/rosr; 2631/rosr; 4427/occob; 4823/occoc; 5305/occob; 5668/occob—A. Dietrich s.n., Feb. 1865/megm—W.B. Donaldson s.n., 2.iii.1939/suav—N.N. Donner 24/gl; 360/vel; 491/gl; 747/gl; 1288/gl; 1704/sim; 1952/gl; 3509/vel; 3548/vel; 3750/gl; 4104/gl; 4164/gl; 4253/sim; 4661/good; 5114/vel; 5165/vel; 5235/vel; 5298/vel; 6425/exc; 6495/occob; 6563/exc; 6564/occob; 6583/occob; 6587/exc; 6633/occob—H.M. Douglas s.n., 7.x.1939/vel—Drake s.n., 19.ii.1917/suav—Duchunty s.n., s.dat./gl—W.P. Dunk s.n., July 1950/vel—C.R. Dunlop 3079/debm; 5028/debm—W.N. Dunlop s.n., 4.ii.1972/vel—L. Durrington 511/gl—J.W. Dwyer 124/gl.

E.H.M. Ealey 161/umb T—C.M. Eardley s.n., 13.x.1934/gl; s.n., May 1940/gl—J. Eastburn s.n., s.dat./gl—Eaves s.n., 1872/debd—J. Ebersohn s.n., 28.iii.1962/vel; 135/vel; 259/gl—J.P. Eckert s.n., 1891/mar—Hj. Eichler 12151/gl; 12475/good; 12946/vel; 13751/vel; 17389/occob; 18375/gl; 18392/good; 19452/mar; 20174/rot—B. Ellis s.n., 17.ix.1976/vel—F.W. Evans s.n., 18.ix.1953/vel; s.n., 21.x.1953/vel—S.L. Everist 9/vel; S23/suav; 59/megm; 222/megs; 1278/vel; 1660/gl; 2895/megm; 3081/megm; 3140/vel; 3141/vel; 3229/megs; 3230/megs; 3267/megs; 3373/megs; 3375/megs; 3318/occob; 3415/megm; 3516/megm; 3672/megm; 3784/megm; 4110/vel; 5019/megm; 5603/vel; 5651/vel; 5710/vel; 5767/vel; 5891/vel; 6115/megm; 7223/gl; 7442/vel.

R.P. Falla 15/vel—T. Fatchen s.n., 29.xi.1976/mar; Q51/gl; Q55/good—I. Felstead s.n., 1878/good—M. Fetherston s.n., Aug. 1962/rosi & vel—R. Filson 1355/vel; 1356/vel; 1357/sim; 3291/vel; 3319/vel; 3454/vel—H.H. Finlayson s.n., s.dat./exc; s.n., Jan. 1934/occob; Dec. 1934/vel—H. Finnemore s.n., Dec. 1928/gl—W.V. Fitzgerald s.n., Nov. 1903/rot; s.n., April 1905/occoc—H. Flecker 4332/mar—J. Flierl s.n., 1883/vel—N.C. Ford s.n., 1.ix.1946/gl—N. Forde 89/vel; 510/vel; 539/vel; 902/exc; 914/exc—J. Forrest s.n., 1878/occoc; s.n., 1881/rot; s.n., Gascoyne River, 1882/cav; s.n., north of Shark Bay, 1882/sim—W. Forsyth s.n., 24.ix.1898/suav—L.S. Francis s.n., 8.v.1953/exc—W.D. Francis s.n., March 1920/debd & gl—L.R. Fraser s.n., 7.x. 1935/gl—E.F. Fricke s.n., s.dat./suav—W.W. Froggatt s.n., Oct. 1928/gl—Fullager s.n., s.dat./suav.

G. Gardiner s.n., 12.viii.1962/vel; s.n., 20.x.1963/good; s.n., 14.vi.1969/occob; s.n., 3.viii.1969/good—H.G. Gardiner 10/rosr—C.A. Gardner s.n., July 1924/rosr; s.n., 25.vii.1927/cav; s.n., July 1931/occob; s.n., 2.viii.1939/rot; s.n., Sept. 1941/occob; s.n., Aug. 1959/cav; 2319/rosr; 2350a/cav; 2444a/cav; 6066/occob; 6070/occob; 6124/occob; 6170a/occob; 6461/rot; 7537a/rot; 7797/cav; 7904/rosr; 12035/cav—A.S. George s.n., 16.ii.1965/rot; s.n., Sept. 1972/occh; 698/rosr; 721/rosr; 743/occob; 811/rosr; 1149/occoc; 1293/occob; 2169/gl; 2495/occoc; 2511/occ; 2561/occ; 2741/cav; 2838/cav; 3730/rosr; 3803/occob; 3837a/rosr; 3837b/sim; 3921/occob; 4036/rosr; 4209/rot; 4471/rosr; 4491/cav; 4539/rosr; 4648/rosr; 4844/occob; 5113/sim; 5165/occob; 5250/occob; 5292/occob; 5549/sim; 5645/cav; 6016/rosi; 6544/occ; 6605/occoc; 7363/rot; 8166/occob; 8217/rosi; 8527/good; 8773/rosi; 8818/ben; 8858/occob; 8870/ben; 8996/ben; 9016/occob; 11386/occh—M.C. George s.n., 16.iii.1963/occob—A.V. Giblin s.n., 27.iv.1928/vel—E. Giles s.n., s.dat./exc; s.n., s.dat./vel; s.n., 1875/sim & vel; s.n., 1880/vel—W. Gill 47/vel—C.H. Gittins 369/amp; 696/megs; 1895/gl; 2037/gos; 2103/exc; 2445/ben—L. Glauret B2703/rosr—D.W. Goodall 629/occoc; 630/occoc; 2460/good—R.H. Goode 84/gl—Gosse 243/gos T—R.A. Gould s.n., 29.ix.1966/exc; s.n., 24.iv.1967/ben—D. & H. Gratte 5/rosr—J.W. Green 11/gl; 69/good—L. Griffiths s.n., Sept.-Oct. 1958/occob—G. Gross s.n., 24.viii.1948/gl; B75/gl—Guppy S.H.4/ben.

Hackhouse s.n., 1881/debd—Hactor s.n., Sept. 1924/vel—E.J. Hadley s.n., May 1907/megm—L. Haegi 621/good; 866/good; 918/gl; 1105/rosr; 1151/rot; 1283/occob; 1355/suav—W.R. Haig s.n., Sept. 1885/gl—H. Haigh & L.D. Williams 6435/gos—R. Hannon s.n., Feb. 1909/gl—D. Hardy s.n., 13.vii.1966/cav—J. Hargreaves W154/megm—W.E. Harney s.n., 1.viii.1935/ben—Hartman s.n., 1873/megm; s.n., 1882/megm—Hasser s.n., 4.xi.1960/gl—H.C. Hayes s.n., Kyogle, s.dat./debd—R. Helms (all collections s.n.) May 1891/vel; 17.v.1891/sim; 7.vi.1891/sim; 11.vii.1891/exc; 12.vii.1891/exc & vel; 24.viii.1891/rosr; Camp 52, 15.ix.1891/occob & rosi; Camp 53, 15.ix.1891/occob T; 17.ix.1891/rosi; 21.ix.1891/roci; 25.ix.1891/rot; 14.x.1891/roci; 23.x.1891/exc; 26.x.1891/roci & rot; 28.x.1891/roci; Oct. 1898/occob; 26.iv.1900/suav—R. Henderson 294/debd; 488/debd—J. Hennelly 92/gl—L. Henry s.n., s.dat./vel—N.M. Henry 598/vel; 792/ben—T. Henshall s.n., Jan. 1966/suav; s.n., 25.iv.1968/good; s.n., 3.viii.1968/vel; 698/gl; 871/good—T.S. Henshall 383/ben; 1341/vel—D.A. Herbert s.n., Oct. 1919/rot—W. Heron s.n., Sept. 1908/suav; s.n., Feb. 1909/gl—A.R.R. Higginson s.n., Oct. 1955/mar; s.n., ca 1955/occob—Hill s.n., 10.xi.1953/occoc—A.V. Hill s.n., 19.xi.1963/suav—F.L. Hill 159/vel—R. Hill 477/vel—F.M. Hilton s.n., 21.viii.1955/good; 544/gl; 653/vel; 835/vel; 1023/good; 1437/sim; 1455/vel; 1472/vel; 1485/vel—P. Hind 43/vel—D. Hockings s.n., May 1957/deb—F.D. Hockings 491/amp—Holding s.n., 1889/gl & vel—A.A. Holland s.n., 6.v.1953/megm—P. Horton 174/gl; 187/vel; 191/vel; 192/sim; 193/sim; 194/occob; 195/sim; 196/occob; 198/vel; 199/sim; 200/vel; 201/occob; 202/good; 203/mar; 204/mar; 205/mar; 206/gl—A.G. Howitt s.n., Sale, s.dat./gl—F. Hughes s.n., March 1920/gl—D. Hunt 744/gl; 3312/mar; 3415/mar—H. Hurst s.n., 1882/gos; 1892/vel—P. Hussey 68/good.

N. Ioannou 25/good—Irvine s.n., 1889/gl & sim—E.H. Ising (all collections s.n.) 29.v.1915/vel; 3.vi.1912/gl; 8.ix.1920/good; 11.ix.1920/good & vel; 15.ix.1920/good; 17.ix.1920/good; Oct. 1922/good; 22.x.1928/good; 23.x.1928/vel; 16.x.1930/mar; 21.viii.1931/vel; 22.viii.1931/ros & sim; 23.viii.1931/vel; 19.viii.1932/vel;

19.viii.1933/vel; 30.viii.1933/rosi; 25.xi.1934/mar; 7.i.1936/gl; 31.vii.1936/rosi; 3.xi.1936/good; 22.viii.1937/vel; 7.ix.1938/mar; 10.ix.1938/mar; 23.ix.1939/mar; Sept.-Oct. 1949/sim; Oct. 1950/sim; 29.vii.1952/vel; 20.ix.1952/exc; 16.vii.1955/sim; 27.vii.1955/sim; 14.viii.1955/sim; 25.viii.1955/sim & ?gl x sim; 26.viii.1955/sim; 2.ix.1955/sim; 14.x.1960/mar.

E.N.S. Jackson 159/vel; 442/vel; 1723/vel; 1852/vel; 1911/vel; 2497/mar; 2739/vel; 2757/vel—G. Jackson 508/gl; 840/mar—G. Jacob s.n., Oct. 1966/vel—S. Jacobs 1303/megs; 1923/gl; 2177/vel; 2227/sim; 2306/gl; 2353/suav—V. Jaegermann 344/gl—James 71/gl—H. James s.n., Nov. 1911/debd—A.E. Jensen s.n., 25.vi.1967/vel—B. Jephcott s.n.,/vel—F. Jessup s.n., 25.xi.1957/vel—L.A.S. Johnson (all collections s.n.) 30.ix.1945/gl; 22.v.1951/debd; 16.iv.1952/suav; 15.vi.1954/suav; 31.x.1954/suav; 3.vi.1955/vel; 4.vi.1955/vel; 18.iii.1959/vel; 23.x.1959/debd; 6.ix.1960/debd; Jan. 1968/debd—L.A.S. Johnson & A. Rodd 1252/debd—R.W. Johnson s.n., 12.x.1954/megm; 500/megm; 751/megm; 1699/gl; 2814/debd—J.G. Johnstone s.n., 25.ix.1915/vel—S. Johnstone s.n., 1883/suav—Jones s.n., 1889/vel—W.T. Jones 1767/megm.

G.M. Kelly s.n., April 1913/megm—J. Kelsall s.n., 21.i.1960/rot—H. Kempe s.n., 1879/gos & occob; s.n., 1881/gos; s.n., 1885/rosi—K.F. Keneally 4181/ben—B. Kennedy s.n., 1885/sim; s.n., 1886/sim—H. Kenny s.n., 2.iv.1917/gl—R.F.B. Kerr s.n., 14.iv.1955/vel—D. Kimber s.n., 24.vii.1977/ben—G. King s.n., 1895/suav—H.S. King s.n., 1886/occ; s.n., 1887/cav—F.H. Kleinschmidt 139/gl—Knox Grammar School s.n., 8.ix.1950/gos—M. Koch (all collections s.n.) 1897/sim; March 1898/sim; May 1898/gl & sim; Aug. 1899/exc, sim & vel; April 1900/gl; 2.x.1923/rot—D.N. Kraehenbuehl 181/mar; 745/vel; 2672/mar—E.C. Kramer s.n., Harper Springs ?1933/rosi T—R.H. Kuchel 144/ben; 214/rosl; 388/occob; 392/occob; 422/exc; 461/gl; 605/vel; 607/sim; 694/vel; 783/vel; 882/vel; 1101/vel; 2940/vel.

D. Laing s.n., June 1961/gl—J. Landy s.n., 4.xi.1960/vel; s.n., 6.xi.1960/gl—R.T. Lange s.n., 17.iii.1962/good—P.K. Latz s.n., 11.ii.1967/gos; s.n., 1.iii.1967/rosi; 133/good; 134/mar; 239/vel; 355/gos; 364/vel; 629/vel; 642/ben; 643/megs; 689/vel; 703/ben; 721/vel; 777/exc; 778/gos; 785/megs; 786/gos; 818/gos; 834/occob; 869/gos; 891/occob; 894/exc; 954/occob; 955/rosi; 1025/gos; 1032/megs; 1051/megs; 1059/megs; 1182/megs; 1273/gos; 1659/megs; 1699/rosi; 1981/rosi; 2145/vel; 2154/megs; 2271/megs; 2394/rosi; 2484/megs; 2500/megs; 2501/megs; 2503/megs; 2503B/megs; 2548/ben; 2549/megs; 2571/megs; 2613/ben; 2662/ben; 3139/occob; 3153/occob; 4104/occob; 4107/sim; 4150/occob; 4153/sim; 4187/ben; 4188/occob; 4191/sim; 4191B/sim; 4204/occob; 4215/gos; 4302/megs; 4325/occob; 4342/occob; 4431/megs; 4654/occob; 4606/vel; 4666/occob; 4686/rosi; 5063/occob; 5081/sim; 5082/occob; 6757/rosi & sim; 6803/sim; 6814/sim; 6869/sim; 6917/megs; 7095/sim; 7116/exc—D. Law s.n., 31.v.1963/gl—B.A. Lay 15/gl; 147/vel; 252/sim; 333/vel—M. Lazarides 5960/vel; 5963/megs; 6060/rosi; 6087/vel; 6192/vel; 6195/gl; 6292/ben; 8196/vel; 8339/rosi; 8352/rosi; 8388/vel—Leichhardt s.n., 18.xi.1843/debd & megm—J.H. Leigh S74/vel; W208/vel—E.E. Lord s.n., 11.iv.1950/exc—T.R.N. Lothian 248/vel; 251/vel; 367/vel; 529/vel; 622/vel; 647/occob & sim; 683/vel; 767/gl; 812/sim; 872/vel; 1069/occob & vel; 1118/vel; 1130/mar; 1180/good; 1401/vel; 1411/vel; 1499/vel; 1641/vel; 1771/vel; 1912/vel; 1956/vel; 1990/vel; 2014/vel; 2037/vel; 2109/vel; 2171/sim; 2294/sim; 2326/gl; 2393/vel; 2426/sim; 2565/vel; 3000/vel; 3176/vel; 3212/vel; 3399/vel; 3458/vel; 3505/vel; 3653/good; 3893/vel; 4369/sim; 4406/rosi; 4421/rosi; 4526/vel; 4784/sim; 4928/occob & sim; 5108a/vel; 5219/vel; 5544/occob; 5593/good—J.M. Luckie s.n., 28.v.1938/suav—H. Ludeman s.n., 5.vi.1955/rot—H. Lynch s.n., March 1912/gl—R.G. Lyons s.n., 15.ix.1971/vel.

D. McAlpine 35/suav—E.J. McBarron 3071/gl; 5716/gl—J. MacCallum s.n., Nov. 1930/megs—J.D. McCormish s.n., Nov. 1936/debd—E. McCrumm s.n., July 1959/good; s.n., s.dat./cav & rosl—T.J. McDonald 72/megm—K.J. McFarlane s.n., 14.viii.1960/vel—D.J. McGillivray 2880/vel—C.L. Mackay s.n., 9.viii.1961/vel—J. Mackay s.n., Oct. 1890/sim—J. McKean 1183/debm T—D. McKechnie s.n., Jan. 1916/gl—H.S. McKee 295/suav; 6784/suav; 8564/vel; 8570/megs; 8576/rosi—E.N. McKie s.n., 19.iv.1939/sim—H.E.S. McLean s.n., 6.i.1957/gl—K. McMahon s.n., 1952/occ—C.J. McMaster s.n., Sept. 1907/gl—A. McPhee s.n., 1890/ben—W. McPherson s.n., 1897/cav—C.T. Madigan s.n., Sept. 1944/rosl—A.J. Mahood s.n., 16.ix.1958/vel—J.H. Maiden (all collections s.n.) Aug. 1899/gl; Nov. 1899/megm; Jan. 1907/mar; March 1909/megm; Sept. 1909/rosl; 21.ii.1913/gl—R.B. Major 1/exc; 50/rosl—E. Marks s.n., Aug. 1967/vel—Marshall s.n., Feb. 1973/good—P. Martensz s.n., 4.xii.1968/gl; 173/suav—W.J.G. Martin s.n., 14.iv.1967/vel—F.A. Mason 207/mar—Z. Mbar 15/gl—A. Meebold 1593/gl; 21869/suav—R. Melville 3150/suav; 3451/megm; 4058/occob; 4225/rot—O.E. Menzel s.n., Oct. 1897/gl—E. Merrill s.n., 1890/rot—J.V. Mertin s.n., 1.vi.1965/good; s.n., 30.x.1965/sim—N. Michael s.n., s.dat./gl & megm; 1257/debd—J.F. Miles s.n., 26.iv.1956/megm—P.L. Milthorpe 729/vel—A. Mitchell s.n., 17.viii.1968/suav—E. Mjöberg s.n., 11.viii.1911/occob T—Moore 823/suav—C.W.E. Moore 3623/gl; 4068/vel; 4144/sim; 4257/gl; 4281/sim; 4615/suav; 4764/gl; 4832/sim; 5758/sim; 6260/sim; 6320/vel—S. Moore s.n., April 1895/rosl T—V.K. Moriarty 765/debd—A. Morris s.n., 24.iv.1920/gl; s.n., 2.x.1920/sim; 4.x.1920/vel T—A. Morrison s.n., 11.x.1905/occob—J. Morrissey 31/rosl—L. Morton s.n., 1881/vel—P.H. Morton s.n., July 1917/gl—W.E. Mossingham s.n., 1889/occ—Muir s.n., 1880/rot—E.T. Muir s.n., 1947/gl—T.B. Muir 900/gl; 901/vel; 2088/suav; 2845/suav—W.E. Mulham 455/sim; 848/vel—A.W. Muller s.n., Dec. 1906/vel—B.J. Murray 19/gl; 106/vel; 430/vel—J. Muspratt 92/debm—J.L. Must 82/vel; 130/vel—P. Myerscough s.n., s.dat./gl.

J.C. deNardi 769/vel; 1025/gl—I.C. Neale s.n., 1888/gl—D.J. Nelson 31/vel; 59/vel; 415/rosl; 497/sim; 583/vel; 628/vel; 719/vel; 875/vel; 876/vel; 1329/vel; 2150/vel; 2213/occob; 2321/sim—A.I. Nesbitt s.n., 25.x.1971/megm—A.O. Nicholls 895/occob—J.B. Nugent s.n., Jan. 1923/gl.

J. Oliver s.n., 1881/good; s.n., 1882/good—R.M. Oliver s.n., 1.vii.1918/gl—M. Olsen & N.B. Byrnes 3560/amp—A.E. Orchard 40/good; 177/gl; 188/good; 229/vel; 253/vel; 348/gl; 350/vel; 763/vel; 780/vel; 964/gl; 1769/good; 2064/good; 2895/good; 3193/good—T.G.B. Osborn (all collections s.n.) 27.v.1922/vel; 30.v.1922/vel; 24.viii.1922/good & vel; 23.viii.1923/vel—P. O'Shanesy 292/gl.

T.B. Paltridge s.n., 15.ii.1930/good; s.n., 23.viii.1930/sim—S.A. Parker 169/gl—R.A.S. Patterson s.n., 8.xi.1922/suav—R.N. Peacock s.n., 1900/sim—K. Peake-Jones s.n., 28-31.viii.1952/vel—R.D. Pearce 33/vel; 64/vel; 103/good; 112/cav; 123/good; 130/vel; 135/sim; 138/vel; 140/sim; 141/sim; 143/good; 145/vel; 147/mar—L. Pedley 764/megm; 2441/sim; 2465/vel—R.A. Perry s.n., Feb. 1938/gl; s.n., Aug. 1943/vel; 2269/ben; 3417/rosi; 3497/gos; 5338/rosi; 5371/vel; 5392/vel; 5407/vel; 5417/vel; 5451/vel; 5451A/vel; 5472/vel; 5473/vel; 5484/vel; 5507/sim; 5529/sim; 5537/sim; 5538/sim; 5550/sim; 5556/ben; 5567/good—H.T. Phillips s.n., Sept. 1953/exc—M.E. Phillips s.n., 3.ix.1962/good; 106/gl—M.A. Picard 5/gl—J. Pickard s.n., 16.ix.1970/debd; 1931/good; 1932/gl; 2357/vel; 2755/debd; 3058/vel; 3138/gl; 3139/vel—J.M. Pidgeon s.n., 20.viii.1939/vel; s.n., 21.viii.1939/gl—J. Pike s.n., 5.ix.1960/good—O.M. Pink 87/vel—Pitcher s.n., 12.xi.1909/suav—E. Plozza s.n., 21.x.1972/gl—A. Popplewell s.n., 6.ix.1960/gl—R. Pullen 4173A/suav; 10488/gos; 10506/rosi—J.D. Purdie s.n., 15.iii.1966/gl—R.W. Purdie 103/megm; 519D/vel.

R. Rae s.n., 24.ix.1937/vel—J. Randles s.n., 8.vi.1971/vel—R.A. Ranking s.n., May 1880/megm—L. Reese s.n., 1933/vel; s.n., March 1924/vel—H. Reeve 372/gl—W.S. Reid s.n., 21.vi.1967/exc—E. Reuss s.n., April 1915/gl; s.n., June 1921/vel—Richards s.n., 1879/good T; s.n., 1880/good—A.F. Richards s.n., Sept. 1890/sim; s.n., 1893/mar—I.P. Richards s.n., Oct. 1886/vel—R. Richards s.n., 20.v.1947/gl—A.E.V. Richardson s.n., March 1931/good; s.n., July 1937/vel—L. Richley M66/vel; F107/sim; 1052/sim; 1162/vel; 1385/sim—I.G. Ridgway s.n., 13.v.1979/vel—E.F. Riek & I. Common 200/gl—C.E. Rix 25/rosi—F. Robbins s.n., Werribee Gorge, ca 1935/suav; s.n., Bete Bolong, ca 1937/suav; s.n., Deddick River, ca 1937/suav; s.n., 27.v.1947/gl—A.E. Roberts s.n., Feb. 1920/megm—J. Robertson s.n., 1894/cav—A. Robinson s.n., Sept. 1959/ben; s.n., June 1972/ben—A. Rodd s.n., Dec. 1965/suav; 412/suav; 1883/gl—F.A. Rodway 6561/suav; 6562/debd; 6564/gl; 6565/gl; 6566/gl; 14253/gl—R. Roe s.n., Oct. 1937/megm—K.C. Rogers s.n., 10.i.1962/suav—R.S. Rogers s.n., Sept. 1907/good—K.D. Rohrlach 549/gl; 712/vel—I. Romano s.n., Nov. 1974/megm—R.A. Rose 128/rot—L.A. Rowe s.n., May 1948/gl—R.D. Royce s.n., Aug. 1936/gl; TS236/occob; 1781/ben; 1977/rosi; 1984/rosi; 2001/occob; 4425/rot; 5923/occh; 6014/occh; 6467/ben; 6508/ben; 9700/rot—H.M.R. Rupp s.n., Sept. 1896/suav; s.n., 6.vi.1927/debd; s.n., Oct. 1927/debd; s.n., Nov. 1932/vel—J.F. Ryan s.n., Aug. 1961/vel.

M.C. Saddler s.n., 17.viii.1967/vel—G.R. Sainty 217/suav—H. Salasoo 1641/suav; 1803/gl—O.H. Sargent s.n., 5.iii.1922/rot—G.V. Scammell s.n., 3.xi.1923/suav—E. Schneider s.n., 1871/megm—M. Schneider s.n., 9.vii.1964/gos; s.n., July 1968/vel; s.n., 8.iv.1970/rosi—R. Schodde 473/vel; 712/gl; 735/good; 830/vel; 831/vel; 981/vel; 1051/mar; 1080/gl—D. Scoles 9/vel—H.R. Seddon s.n., April 1924/vel—W. Semple 740/gl—T.L. Setter 260/occob; 292/rosi; 363/rosi—M.C.R. Sharrad s.n., 14.viii.1960/mar; 286/mar; 308/gl; 1405/vel; 1431/good—R.C. Shearer 123/good—C.J. Shepherd 128/gl; 131/gl; 721/gl—C.J. Shepherd & M. Gray 5632/suav—P. Short 5/gl—J.H. Simmonds s.n., June 1887/debd; s.n., 26.i.1888/debd—L.S. Smith 365/gl; 612/megm; 907/vel; 3461/debd; 4419/gl—T. Smith s.n., 26.v.1967/mar; 452/mar; 1954/gl—W. Smith s.n., Dec. 1932/megm—W.F. Snewen s.n., March 1948/amp—R.V. Southcott s.n., 29.ii.-1.iii.1964/gl—R.L. Specht s.n., 3.iv.1950/gl; 2214/good; 2840/good—N.H. Speck 640/rosi; 940/rosi; 996/occob; 996A/cav; 996B/occob; 1008/cav; 2009/gl—A.G. Spooner 1878/good; 2855/good; 3227/mar; 3370/good; 3588/mar; 4291/vel; 4306/mar—M.S. Stevens s.n., Dec. 1954/amp; s.n., 29.xii.1954/megm & vel—P.R.H. St John (all collections s.n.) 5.iv.1899/suav; 21.iii.1901/suav; 29.ii.1904/suav; 12.iii.1904/gl & suav; 13.iii.1904/gl; 11.x.1906/suav—G.M. Storr s.n., 6.ix.1959/occh; s.n., 14.ix.1959/occh; s.n., 22.x.1961/occh—C. Stout s.n., 16.ii.1913/gl—K. Stove 562/occob; 680/sim—W.F.M. Straatmans 23/suav—H. Suijndorp 117/umb—R. Swinbourne 355/megs; 372/rosi; 384/megs; 397/rosi; 428/vel; 1402/gl—G.D. Swincer s.n., 14.x.1961/gl—D.E. Symon s.n., 27.v.1953/vel; s.n., 2.vi.1953/vel; s.n., 5.vi.1953/gos; s.n., 6.vi.1953/gos & vel; s.n., 10.vi.1953/rosi; s.n., 12.vi.1953/exc; s.n., 14.vi.1953/gos; s.n., 15.vi.1953/gos; s.n., 17.vi.1953/exc; s.n., 18.vi.1953/vel; s.n., 30.iii.1958/mar; s.n., 27.ix.1959/good; s.n., 30.ix.1959/good; s.n., 16.xi.1965/rosi; s.n., Sept. 1968/gl; 522/good; 662/vel; 1301/gl; 1155/good; 1883/good; 2082/good; 2459/ben; 2472/rosi; 2562/exc; 2709/sim; 3045/vel; 3046/gl; 3214/mar; 3292/vel; 3336/exc; 3563/gl; 3652/good; 3786/good; 3792/vel; 3870/good; 4000/vel; 4500/good; 4555/good; 4627/good; 4657/good; 5458/cav; 5580/gl; 5691/vel; 5848/vel; 6030/vel; 6071/occob; 6533/mar; 6613/mar; 7288/vel; 7294/gl; 7326/vel; 7428/gl; 8016/gl; 8027/vel; 8112/vel; 8333/gl; 8818/good; 8855/mar; 8927/mar; 9013/mar; 9076/sim; 9142/sim; 9180/sim; 9263/sim; 9299/vel; 9422/vel; 9459/vel; 9899/good; 9904/vel; 9905/good; 9914/sim; 9926/occob; 9949/cav; 9960/rosi & sim; 10385/rosi; 10561/gl; 10563/mar; 10581/vel; 11028/vel; 11225/vel; 11287/occob; 11287A/sim; 11288/sim; 11288A/sim; 11445/sim; 11448/gl; 11468/sim; 11472/sim; 11544/vel; 11559/vel.

Tadgell s.n., April 1910/gl—R. Tate s.n., 1894/rosi—A. Taylor s.n., 20.vi.1957/debd—G.F. Telfer 101/vel—J.G.O. Tepper s.n., 1879/good & mar; s.n., March 1880/gl; s.n., s.dat./gl—A.R. Tewksbury s.n., Feb. 1949/suav—R.J. Thiele s.n., 22.viii.1970/gl—D.F. Thompson 1709/megm—J. Thompson 1068/gl; 1118/megm—R.F. Thornton s.n., 1889/gos & vel; s.n., 1891/gos—W.H. Tietkens s.n., 1889/gos—N.B. Tindale s.n., 11.vii.1933/exc; s.n., 8.xi.1934/vel; 22.ix.1953/ben—A. Tiver s.n., 5.xii.1978/vel; s.n., 12.xii.1978/good—M.A. Todd s.n., 16.i.1966/gl—H.R. Tolken 6328/occob; 6329/ben; 6355/occob; 6378/occob; 6407/occob—

J.G. Tracey s.n., 1958/debd; C280/debd—H. Tryon s.n., 1909/gl—Tucker s.n., 1879/vel—E.M. Tucker s.n., 14.vi.1969/vel—E.C. Tuckwell s.n., May 1954/gl—R. Tully s.n., March 1893/gl—A.J. Turner s.n., Sept. 1920/megm—H. Turner (all collections s.n.) 11.ii.1960/good; 20.ii.1960/good & occob; 23.iii.1960/occob; 21.viii.1960/good; 4.ix.1960/good; 26.ix.1960/occob—F.T. Turvey (all collections s.n.) 16.iv.1966/sim; 21.v.1966/exc; 2.vii.1966/sim; 15.viii.1966/gos; 3.viii.1968/exc; 11.viii.1968/gos—I. Tyson s.n., 1892/occob & sim.

F.H. Vachell s.n., Dec. 1903/rot—J. Vickery s.n., 20.xii.1934/gl; s.n., 19.viii.1946/vel—R.S. Vickery s.n., 3.i.1957/good; s.n., 5.i.1957/good—A. Vogan s.n., 1889/sim & vel.

N.A. Wakefield 3928/suav—Wallace s.n., July 1972/gos; s.n., 12.viii.1973/gos—N. & P. Wallace s.n., June 1973/gos—H. & J. Walsh s.n., 1894/occob—C. Walter s.n., Sept. 1899/suav—C. Walters s.n., 1898/rot—Warburton s.n., s.dat./vel—H.M. Ware s.n., Oct. 1949/suav; s.n., Aug. 1950/suav; s.n., 17.vii.1951/gl; s.n., 8.xii.1954/suav—C. Warner s.n., Aug. 1955/sim—F.D. Warren s.n., s.dat./vel—J.T. Waterhouse s.n., Jan. 1948/megm; s.n., May 1954/gl—F.J. Webb s.n., May 1901/vel—J. Webb s.n., 19.ix.1957/suav—L.J. Webb 2276/debd & megm—J.Z. Weber 550/gl; 666/gl; 794/occob & sim; 977/gl; 981/vel; 1221/vel; 1344/vel; 1437/vel; 1520/vel; 2069/vel; 2110/vel; 2264/vel; 2399/vel; 2562/gl; 2632/vel; 3328/vel; 3331/gl; 3415/gl; 3508/gl; 3561/good; 3649/good; 3777/gl; 3885/mar; 3908/mar; 4558/vel; 4654/vel; 5259/occob; 5260/occob; 5273/occob; 5391/occob; 5477/occob; 5580/exc; 5685a/sim; 5685b/vel; 5719/vel; 5798/vel; 5938/vel—L. Webster s.n., 1898/rot—J. Wedd s.n., Nov. 1891/debd—H.J.N. Wehl s.n., 1892/megm—M.G. West s.n., 15.x.1972/gl—A. Weston s.n., 1892/occ—T. & J. Whaite 1947/suav—Wheeler s.n., s.dat./vel—J.R. Wheeler 444/gl; 790/mar—D.J.E. Whibley 259/good; 568/good; 889/gl; 1117/rosr; 1122/exc; 1156/sim; 1184/exc; 1250/vel; 2150/vel; 2209/vel; 2222/gl; 2313/gl; 2316/vel; 2362/vel; 2370/vel; 2466/vel; 2513/vel; 2572/vel; 3416/vel; 3431/vel; 3493/vel; 3571/vel; 3871/vel; 3981/vel; 4004/gl; 4062/vel; 4424/vel; 5473/good; 4577/gl; 6415/occob; 6569/occob—C.T. White s.n., March 1915/gl; s.n., 13.v.1917/debd; 10394/megm; 10881/debd; 11359/debd; 11656/megm; 12018/vel; 12019/vel; 12228/megm; 12488/debd; 12559/debd—S. White s.n., s.dat./vel—S.A. White s.n., s.dat./vel; s.n., 12.viii.1914/exc T; s.n., 23.viii.1914/vel—D.G. Wilcox s.n., 7.vii.1970/occob; 63/occob—C. Wilhelm s.n., s.dat./mar; s.n., March 1857/suav—M.C. Willcocks 20/good—K. Williams 89/vel—L.D. Williams 578/mar; 1596/gl; 2831/vel; 3493/gl; 5252/mar; 6386/vel—Williamson s.n., Hopetown, s.dat./suav—J.H. Willis (all collections s.n.) 29.viii.1947/good; 29.viii.1948/vel; 10.ix.1950/vel; 11.ix.1950/vel; 20.x.1955/suav; 27.v.1961/debd; 18.x.1961/good; 22.ii.1962/suav; 11.iii.1963/suav; 5.ix.1963/good; 11.ix.1965/gos; 20.viii.1966/vel; 23.vii.1966/vel; 28.vii.1966/gos; 13.v.1969/suav; 30.ix.1969/suav—V. Willis s.n., May 1920/gl—K.L. Wilson 1295/megm; 1612/gl; 1916/megm—P.G. Wilson s.n., 28.ii.1954/gl; 129/gl; 480/mar; 569/gl; 1631/good; 1659/good; 1682/good; 1689/gl; 2178/good; 2546/occob; 2590/sim; 3911/rot; 7221/occob; 7650/good; 10504/occob—J. Wilton s.n., Jan. 1914/gl—R.E. Winkworth 26/vel; 479/vel; 601/vel; 795/gl; 1233/vel; 1374/roci—C. Winnecke s.n., 1883/ben & rosi—G. Wittmann s.n., 27.viii.1964/vel—S.T. Woenne 104/occob—J. Womersley 4/gl—W. Woolley s.n., 1871/megm; s.n., 1886/vel—Woskett s.n., 14.x.1955/exc—J.W. Wrigley 5903/gl—A. Würfel s.n., Oct. 1884/gl & vel—Wuth s.n., 1870/megm—E.S. Wyndham s.n., March 1919/gl.

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THE SPECIES OF *CRASSULA* L. IN AUSTRALIA

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Abstract

A taxonomic revision of the genus *Crassula* in Australia is presented together with a key to the 17 taxa recognized. *C. colorata* var. *tuberculata* Toelken and *C. sieberana* subsp. *tetramera* Toelken are described while the combination *C. colorata* var. *miriamiae* (Ostenf.) Toelken is made.

Introduction

The similarity of some of the Australian species of *Crassula* to the South African ones prompted the present research, which can be seen as a continuation of the earlier study on the South African species (Toelken, 1977). Similar problems such as the wide ecological and local variation as well as the difficulty of identifying herbarium material of some taxa are also encountered in Australia. As in the South African annual species, no putative hybrids were found here. However, the close resemblance of some of the Australian species to those of other continents compounds the problem of evaluating the variation within the geographical boundaries. Of the 11 taxa indigenous to Australia 5 also occur outside this area and, although the present study is almost entirely based on specimens from Australian herbaria, the limited number of specimens from outside were found adequate for decisions to be taken. Most of the work was done on herbarium specimens and only here and there were critical areas visited to investigate problems in situ. However, living or pickled material of all the species was investigated and its range of variation is included in the descriptions. In the case of *C. moschata* and *C. sarmentosa* too few Australian records were available so that the range of variation was extended to that found outside this continent.

History

Tillaea sieberana J.A. & J.H. Schultes (1827) was the first species in the Crassulaceae described from Australia, based on material collected by Sieber near Sydney. Hooker (1841) and Nees (1844-5) described another six species but Bentham (1862) recognized only four species in his 'Flora Australiensis'. Since then a few species have been added at intervals but no revision of the genus for the whole continent has been undertaken.

In all the early treatments the species were placed in the genus *Tillaea* partly because they often had 4-merous flowers (as opposed to 5-merous ones in *Crassula*) and partly because of their annual habit (*Crassula* spp. are predominantly perennials). Occasionally the genus *Bulliarda* was used for Australian species and the delimitation of each of the three genera was revised by each subsequent author. Schonland (1890) in his review of the whole family concluded that characters used were often not consistent and amalgamated genera such as *Bulliarda* and *Tillaea* with *Crassula* but upheld some of these as lower ranking taxa. He did not enumerate all species so that Ostenfeld (1918) was the first to place all the Australian species in the genus *Crassula* and most subsequent authors followed him.

The genus *Crassula* is represented by only a few species in Australia so that it is not unexpected that the subgeneric groupings were established in Southern Africa, which is the major centre of distribution of the genus. The species indigenous to Australia fit well into the two sections recognized in South Africa (Toelken, 1977). The species native in

Australia can be placed into two sections *Helophytum* and *Glomeratae* and the genus *Bulliarda* should be placed in the former section while *Tillaea* is placed into the latter. Both sections have an almost world-wide distribution and many other names have been proposed and the levels changed with every new treatment. The proposal for raising the status of *Helophytum* from sectional to subgeneric level by Friedrich (1979, p. 578) is not acceptable to the present author because it takes the one group out of context with others (for discussion see under *The Inflorescence*).

Five South African species and *C. alata*, from the eastern Mediterranean region, are definitely naturalized in Australia. The first record of these is of *C. natans* from near Perth in 1883 and now the species has spread through much of the wetter areas of the winter rainfall region of Australia. This species seems to be actively spreading from south-western Western Australia and southern South Australia where it is already well established. The first records from western Victoria have recently been collected. In contrast, *C. thunbergiana* was for the first time recorded also from near Perth in 1889, but has not spread beyond the south-western parts of Western Australia, where it is never common. The latest species found naturalized in some areas are *C. sarmentosa* and *C. tetragona*, both being widely cultivated as are many other South African species.

Taxonomic Characters

In small annuals such as the Australian species of *Crassula* all characters are so variable that few reliable taxonomic characters can be found. However, in spite of the extreme variation a high percentage of specimens can be identified by auxiliary characters when the main character cannot be used for one or other reason. A 'normal' range of, for instance, measurements of the leaves is, therefore, accentuated by placing extreme values in brackets. In the case of *C. moschata* and *C. sarmentosa* these extreme values were obtained from specimens collected outside Australia, because too few specimens were available to include what is considered a full range of variation.

C. helmsii and *C. natans* should both theoretically show two ranges of 'normal' measurements depending on whether the plants grow on marshy soil or are submerged. In practice this is quite unworkable as herbarium specimens rarely indicate whether the plants were only recently inundated or well established in standing water. Only one range of measurement is therefore provided in the description although in practice the majority of specimens will fit in either the upper or the lower part of the range. To counter this unusual phenomenon the full range of variation is discussed under each of the two species because they are at times not easy to distinguish.

The Inflorescence

In the revision of the South African species of the genus *Crassula* (Toelken, 1977) the inflorescences were partly interpreted in terms of Troll's concepts but used together with conventional terminology. The inflorescences of the predominantly annual species cannot be interpreted and compared with those of the perennials unless one accepts the interpretations of Troll (1964, 1969). As a change from conventional terminology was necessary, the clearly defined concepts of Briggs and Johnson (1979), which are based on Troll's work, are largely adopted here.

The complex thyrsoid is the fundamental inflorescence type in the Crassulaceae and all modifications can be derived from it. In the case of the annual species, for example *C. decumbens*, the inflorescence is usually a frondo-bracteose complex thyrsoid (fig. 1, A), but in 'shade' plants it will often be a frondose inflorescence which gives the whole plant an entirely different appearance. In some species the plasticity of the inflorescence is very great, and *C. decumbens* is one of them. Normally the complex thyrsoid consists of several dichasia at the apex and thyrsoids towards the base but under

extreme conditions it can be reduced to a terminal dichasium, (fig. 1, B), a binodal botryoid, a triad or even only a single terminal flower. Within one population the whole range can be found as shown by the collections *Kraehenbuehl* 676, 1468. It was possible to confirm the observation by Wydler (1878, p. 351) who noted that *Bulliarda trichotoma* (synonym of *C. decumbens*) produces a terminal inflorescence after the third to fifth node. Troll (1969, p. 240) interpreted this juvenile stage (up to the third node) as a very much reduced vegetative growth and it becomes comparable with vegetative branches of species in the section *Petrogeton* where never more than four or five pairs are found, but in some cases it is reduced to a single pair.

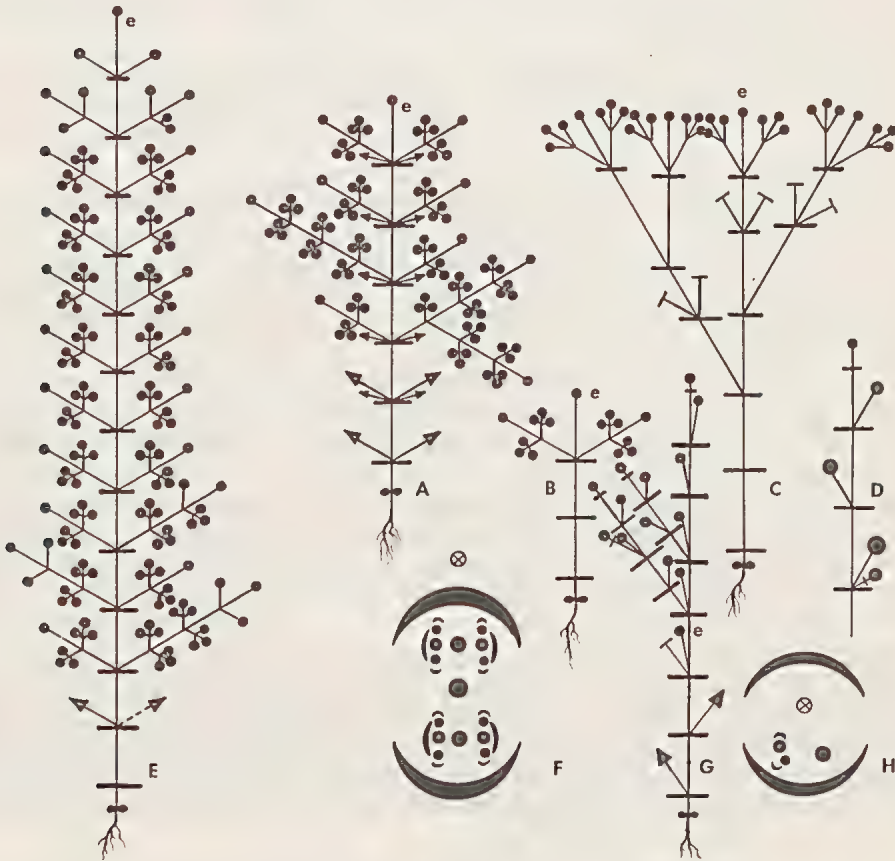


Fig. 1. Diagrams of types of inflorescences found in annual *Crassula* species. A, *C. decumbens*, well developed plant (Toelken 6443); B, *C. decumbens*, depauperate plant (Kraehenbuehl 629); C, *C. glomerata*, well developed plant (Boorman in NSW 143675); D, *C. natans*, flowering branch (Toelken 6422); E, *C. exserta*, well developed plant (Toelken 6421); F, *C. decumbens*, dichasium (Toelken 6443); G, *C. natans*, well developed plant (Eichler 16414); H, *C. natans*, sequence of development of flowers at one node (Toelken 6422); e, terminal flower; large arrow indicates potential position of additional inflorescences similar to the terminal one; small arrows indicate position of potential accessory inflorescences; T, part-inflorescences often suppressed at first but developing later.

Under favourable conditions even the lowest two nodes, and sometimes even the node which bore the cotyledons will develop axillary branches, which in turn may or may not bear flowers on its first node. Usually, however, each of these branches is a thyrsoid or complex thyrsoid with flowers even from the basal node in *C. decumbens*. The whole plant consists ultimately of a terminal and several lateral thyrsoids or complex thyrsoids and mature specimens may be interpreted as a complex thyrsoid because the developmental sequence can no longer be recognised.

Fig. 1: A, B, C, E show dichasia each with only seven flowers but often the numbers will increase depending on the species and on prolonged favourable conditions. The sequence in which the flowers mature on the inflorescence varies somewhat in different species but most of the time they develop according to the plan (fig. 1, F). Sometimes, however, some flowers may be suppressed and only develop later, if at all, so that the dichasia end in monochasia. A similar suppression of one of a pair of part inflorescences or whole lateral inflorescences at a node is occasionally found in some species but usually the branch develops later.

Accessory inflorescence branches (fig. 1, A) are quite common in well developed specimens of this species, but rare in others. Depending on conditions they usually consist of a thyrsoid with one to several pairs of dichasia or rarely are reduced to a binodal botryoid or a triad.

In spite of all this possible variation there are three main developments distinguishable among the species of *Crassula* in Australia.

1. A basitonic development of the inflorescence results in an elongation of the inflorescence as additional flowers are produced at nodes towards the base of the branch. In *C. exserta* (fig. 1, E), *C. colorata* and *C. sieberana* the effect is accentuated by the sessile lateral part-inflorescences which produce rarely more than one dichasium. In depauperate plants sometimes the upper two or more nodes of the terminal axis, and of the lower lateral axis, develop only monads so that the inflorescence is a panicle. This condition is, however, rare and in such cases there are usually other specimens in the same collection with a normal inflorescence.

Although the inflorescences in the Crassulaceae tend to be anthotelic they sometimes become auxotelic as in *C. sieberana* subsp. *sieberana*. Sometimes it is even possible to find anthotelic and blastotelic inflorescences at the apex of different branches of the same plant. It has, however, only been observed in perennial plants with a pronounced basitonic development of the inflorescence.

2. In an inflorescence with a pronounced acrotonic development the flowers are all aggregated at the apex into a corymb-like inflorescence as found in *C. glomerata* (fig. 1, C). Plants of this species are usually sparsely branched but many of the upper uniflorescences develop only later if favourable conditions prevail. It is typical of this species that often only one of the two axillary branches develops at a node, so that an apparently dichotomous branching can be observed. The single branches are arranged rather haphazardly around the main axis.

3. The flowers of the species of the section *Helophytum* seem to be axillary. However, the absence of a bud in the axil of the leaf (not appearing to subtend the flower) can be shown by severing the growing point as in all cases studied an axillary branch developed between the flower and its subtending leaf. The severed axis had, therefore, developed from the other axillary bud at that node. This 'classical' example of sympodial growth is often claimed to represent a radical difference from other growth patterns in *Crassula*, and it seems tempting to redefine either *Bulliarda* or *Helophytum* on this basis. However, as any cymose inflorescence is an example of sympodial growth, it is important to delimit the inflorescence as opposed to vegetative growth.

Troll (1969, p. 240-2) reviews the detailed studies by Caspary (1860) on *Bulliarda* (*Crassula*) *aquatica* which develops the first flower (i.e. the terminal flower) on the fourth node. Like *C. decumbens* (see earlier), first a short period of vegetative growth takes place which terminates in a monochasium or sometimes in a dichasium with monochasial branches, as is commonly found in other genera of the family, e.g. *Cotyledon* (Toelken, 1978, p. 378). However, in most species of the section *Helophytum* the monochasia are often branched by subsequent development of the second axillary bud of some nodes (fig. 1, G), and the temporary suppression of this second axillary branch at some nodes was already described in both *C. decumbens* and *C. glomerata*.

Troll's illustration of *Bulliarda vaillantii* (fig. 196, I) also shows that the three basal 'vegetative' nodes each produce an axillary branch terminating in a dichasium with monochasial branches. The whole plant of *C. natans* and *C. helmsii* is comparable with the morphology of *C. decumbens* except that the terminal and lateral branches of the inflorescences tend to be monochasia. The occasional dichasium, however, shows that a generic delimitation based on monochasial as opposed to dichasial development, as sometimes suggested, cannot be accepted especially as similar monochasial inflorescences are also found in *C. pellucida* subsp. *alsinoides* (Toelken 1977; p. 185) which is placed into an entirely different section.

In the case of *C. natans*, and particularly in plants of it which are growing in marshy conditions, sometimes up to three flowers are found on the one side of the node. Two of these flowers usually develop somewhat later (fig. 1, H) so that it may be concluded that they belong to a slightly displaced and very much reduced axillary or accessory monochasium. It seems, however, more likely to represent an axillary branch as accessory inflorescences have not been recorded for any species of the section *Helophytum*.

The Flowering Period

Ephemerals, such as most of the *Crassula* species indigenous to Australia, must be closely synchronized with their environment in order to survive. They often complete their life cycle in less than one month. Their seeds will usually only germinate after a good rain so as to ensure new seed production. Consequently in the southern parts of Australia the flowering period for most species is from August to November. The exceptions are *C. helmsii*, *C. natans* and *C. peduncularis* which will continue to flower as long as water is available, and flowering specimens for at least the first two species have been recorded in each month of the year.

Similarly, flowering specimens of both subspecies of *C. sieberana* have been recorded during summer from the summer rainfall areas of New South Wales and Queensland as well as during winter in the predominantly winter rainfall areas of Victoria and South Australia. The flowering period of *C. sieberana* subsp. *sieberana* tends to be slightly later than that of the subsp. *tetramera*, but under favourable conditions both subspecies will continue flowering for some time, so this characteristic cannot even be used in the field.

Distribution

The genus *Crassula* is mainly found in temperate regions of the world with the greatest number of species occurring in South Africa. Most of the perennial species are restricted to the African continent. The greatest number of annuals are also found in Africa but some have been described from many parts of the world excluding most areas with tropical climate.

Australia, together with New Zealand, is the area with the greatest number of species outside Africa, in spite of the few species indigenous to this area. These predominantly annual species show in Australia a similarity with the South African species in that the

greatest number are found in the winter rainfall areas although they usually extend also into adjoining areas.

C. decumbens is the only species native to both South Africa and Australia. The apparent similarity between *C. thunbergiana* (South Africa) and *C. sieberana* subsp. *tetramera* (Australia) seems to be superficial. *C. decumbens* is widely distributed in Australia but does not occur in New Zealand. In contrast to this, *C. peduncularis* occurs from the southern parts of Australia to those of South America, while *C. moschata*, which has recently been recorded from Tasmania, has a southern circumpolar distribution. All this indicates the divergent elements found in Australia.

In Australia the genus is mainly restricted to the temperate region with only a few species extending their distribution into adjoining areas. *C. sieberana* subsp. *tetramera* and *C. colorata* var. *tuberculata* are also widespread in sheltered rock crevices of the central region with dry continental climate.

The gap in the distribution associated with the Nullarbor desert has been proven to be due to insufficient collecting at least in some species. Marsh plants will obviously not find suitable habitats in that area. It is, however, noteworthy that *C. helmsii* and *C. peduncularis* have only been recorded a few times west while *C. exserta* has been recorded much more frequently from the west than east of this gap.

CRASSULA L.

L., Sp. Pl. ed. 1:282 (1753); Gen. Pl. ed. 5:136 (1854); DC., Prodr. 3:383 (1828); Ostenfeld, Dansk. bot. Ark. 2,8:39 (1916); Berger, Pflanzenfam. ed. 2, 18a: 386 (1931); Toelken, Contr. Bolus Herb. 8:39 (1977).

Type: *C. perfoliata* L.

Tillaea L., Sp. Pl. ed. 1:128 (1723); Gen. Pl. ed. 5:62 (1754); Benth., Fl. Austr. 2:450 (1862); Benth. & Hook. f., Gen. Pl. 1:657 (1865).

Bulliarda DC., Bull. Sc. Soc. Philom. 3:1 (1801); Prodr. 3:382 (1828).

Annuals or perennials with prostrate, decumbent or erect habit, with carnosely branches to 1 m long. *Leaves* opposite, sessile or rarely petiolate, usually entire, sheathing at the base, more or less succulent. *Inflorescence* a thyrsoid with one to many dichasia, rarely reduced to a solitary flower, often with bracts leaf-like. Flowers 3-5-merous. *Calyx* slightly fused at the base, with lobes often unequally long. *Corolla* shortly connate. *Stamens* in one whorl alternating with the petals, adnate to base of corolla. *Squamae* opposite carpels, dorsiventrally compressed. *Carpels* free or slightly sunk into the receptacle.

The genus is represented by only a few herbaceous, mainly annual, species in Australia while the greatest number (145 species) is found in South Africa. Many of the latter are grown in local gardens and some escapes have become naturalized, others have been accidentally introduced and are spreading as weeds.

Key to species and subspecific taxa

1. Flowers borne well above leaves (bracts, if present, scale-like); perennials 2
 Flowers borne in axils of leaf-like bracts; annuals, or if perennials, leaves shorter than 12 mm 3
2. Leaves serrate, flat (sect. *Anacampteroideae*) 13. *C. sarmentosa* var. *sarmentosa*
 Leaves entire, terete or almost so (sect. *Acutifolia*) 14. *C. tetragona* subsp. *robusta*
3. Calyx $\frac{1}{2}$ - $\frac{2}{3}$ of the length of corolla; flowers 1 (-3) from 'axil' of one leaf per node (sect. *Helophytum*) 4
 Calyx longer than or as long as corolla; flowers (1-) 3-18 in axils of both leaves at a node (sect. *Glomeratae*) 7



Fig. 2. A-C, *Crassula natans* var. *minus*: A, branch of plant growing in water, X 1; B, flower with fruit, X 10 (A & B, Alcock 968); C, plant growing on moist soil, X 1 (Weber 1764). D-F, *C. helmsii*: D, branch of plant growing in water, X 1; E, flower with fruit, X 10 (D & E, Eichler 17731); F, branch of plant growing on moist soil, X 1 (Eichler 14879). G, H, *C. pedicellosa* (Chinnock 4104): G, whole plant, X 1; H, flower with fruit, X 10. J, K, *C. decumbens* var. *decumbens* (Chinnock 4103): J, whole plant, X 1; K, flower with fruit, X 10. L, M, *C. peduncularis* (Morrison, 24.x.1891): L, whole plant, X 1; M, flower with empty pericarps, X 10.



Fig. 3. A-C, *Crassula glomerata* (Boorman in NSW 143675): A, whole plant, X $\frac{1}{2}$; B, fruit, X 20; C, flower with fruit, X 10. D, E, *C. exserta* (Toelken 6421): D, whole plant, X $\frac{1}{2}$; E, flower with fruit, X 10. F-H, *C. sieberana* subsp. *sieberana* (Toelken 6546): F, branch with segmented base, X $\frac{1}{2}$; G, pericarp with seeds shed, X 20; H, flower, X 10. J-L, *C. sieberana* subsp. *tetramera* (Toelken 6547): J, whole plant, X $\frac{1}{2}$; K, flower, X 10; L, pericarp with seeds shed, X 20. M, N, *C. alata* (Toelken 6548): M, branch, X 1; N, flower, X 20. O-Q, *C. thunbergiana* subsp. *thunbergiana* (Toelken 6439): O, small plant, X $\frac{1}{2}$; P, flower with fruit, X 10; Q, fruiting carpel, X 20. R, S, *C. colorata* var. *tuberculata* (Toelken 6424): R, whole plant, X $\frac{1}{2}$; S, fruit, X 20. T, —var. *miriamiae*, fruit, X 20 (Ostenfeld 1452). U, —var. *colorata*, fruit, X 20 (Toelken 6491). V, W, *C. moschata* (Allen in HO 30959): V, small plant, X $\frac{1}{2}$; W, flower, X 10.

4. Carpels each with one ovule 4. *C. natans* var. *minus*
Carpels each with (2-) 4-16 ovules 5
5. Leaves obovate to spatulate 1. *C. moschata*
Leaves linear to oblong-elliptic 6
6. Style less than $\frac{1}{4}$ of the length of ovary and abruptly joining ovary; leaves rarely to 1 mm broad 2. *C. peduncularis*
Style about half as long as and gradually tapering into ovary; leaves (1-) 1.5-2.5 (-3) mm broad 3. *C. helmsii*
7. Inflorescence a flat-topped terminal thyrsoïd 8
Inflorescence elongate, terminal or axillary 9
8. Fruiting pedicels absent (rarely to 4 mm on first flower of inflorescence) 5. *C. glomerata*
Fruiting pedicels 4-15 mm long 6. *C. pedicellosa*
9. Flowers predominantly 3 or 4-merous 10
Flowers predominantly 5-merous 12
10. Flowers 3-merous 12. *C. alata* var. *alata*
Flowers 4-merous 11
11. Basal branches carnose, articulated with swollen nodes; follicles opening along the whole suture 9a. *C. sieberana* subsp. *sieberana*
Basal branches wiry-woody, not articulated; follicles opening by apical pore 9b. *C. sieberana* subsp. *tetramera*
12. Flowers sessile or almost so 13
Flowers with pedicels at least 1.5 mm long 16
13. Follicles dehiscent by apical pore and basal circumscissal split 10. *C. exserta*
Follicles dehiscent only by basal circumscissal split 14
14. Follicles inflated, abruptly constricted into style 11b. *C. colorata* var. *miriamiae*
Follicles laterally compressed, gradually tapering into style 15
15. Follicles almost elliptic in profile, smooth or rarely with bulging epidermis cells 11a. *C. colorata* var. *colorata*
Follicles oblanceolate to almost spatulate in profile with clusters of tubercles below the middle 11c. *C. colorata* var. *tuberculata*
16. Carpels each with (1) 2 ovules 17
Carpels each with 8-20 ovules 18
17. Calyx lobes sharply pointed 10. *C. exserta*
Calyx lobes blunt 8. *C. thunbergiana* subsp. *thunbergiana*
18. Calyx lobes papillose; peduncles absent 6. *C. pedicellosa*
Calyx lobes smooth or with few papillae towards the apex; peduncle 3-7 mm long 7. *C. decumbens* subsp. *decumbens*

A. sect. **Helophytum** (Eckl. & Zeyh.) Toelken, Contr. Bolus Herb. 8:84 (1977).

Type: *H. natans* (Thunb.) Eckl. & Zeyh.

Helophytum Eckl. & Zeyh., Enum. 288 (1836); Harv., Fl. Cap. 2:328 (1862).

Annual herbs usually. *Inflorescence* a terminal and often axillary thyrsoïds with mainly monochasial branches; flowers 1 (3-) in the axil of one of the leaves at a node due to sympodial growth. *Calyx* to $\frac{2}{3}$ of the length of the corolla, with lobes usually obtuse. *Carpels* with obovoid ovaries abruptly constricted into short styles.

This section has an almost world-wide distribution but individual species usually do not cover a very wide area.

1. *C. moschata* Forst. f., Commentat. Soc. Regiae Sci. Gott. 9:26 (1787).

Type: South America, 'Statenland prope Terra de Fuego', J.R. & G. Forster (BM, 3 spec. AD, photo!).

Bulliarda moschata (Forst. f.) Urv., Mem. Soc. Linn. Paris 4: 618 (1826).

Tillaea moschata (Forst. f.) DC., Prodr. 3:382 (1828); Hook., Ic. Pl. 6, pl. 535 (1843); Allan, Fl. N.Z. 1:197 (1961).

Annuals or perennials (?) with prostrate to decumbent axes 2-5 (-15) cm long, rarely branched. *Leaves* obovate, spatulate or rarely oblanceolate, 1.5-3 (-5) x 1.5-2.5 mm, obtuse, often subpetiolate, almost flat above and distinctly convex below, green. *Inflorescence* reduced to single terminal flower in axil of one of the leaves at a node; pedicels 1-2 mm long; flowers 4-merous. *Calyx*: lobes broadly triangular, 0.8-1 mm long, obtuse, glabrous, slightly fleshy, green. *Corolla* cup-shaped, white; lobes oblong-oblanceolate 1.3-1.5 (-2) mm long, obtuse, recurved. *Squamae* oblong-cuneate 0.3-0.5 x c. 0.2 mm, truncate, pale yellow. *Ovaries* obovoid, each abruptly constricted into short thin style arising from the inner margin, with 2-4 (-8) ovules. *Follicles* smooth, recurved, splitting along the whole suture; seeds smooth or almost so. (Fig. 3, V & W).

Growing on wet rocks near the coast; recorded only from Gull Reef near Port Davey (Tasmania).

The species is only known from a single recent record from Tasmania, although Hooker (1841) had expected it to be found there. This specimen, which was raised in cultivation, does not fit the description which Allan (1961) provides for *C. moschata* in New Zealand because it has neither 6-8 (-10) ovules per carpel nor leaves longer than 5 mm. However, the type specimens of *C. moschata* shows a wider range of variation in the length of the leaves and in the protologue the species is described to have 3 or 4 seeds per follicle.

The extreme measurements of some organs provided in brackets in the above descriptions were taken from specimens from outside Australia in order to facilitate a broader species concept in case more robust specimens are found. Much more material would be needed for a clear evaluation of the variation of the species and its local forms.

Specimens examined

TASMANIA: M. Allan in HO 30959, Gull Reef (HO).

2. *C. peduncularis* (Sm.) Meigen, Bot. Jb. 17:239 (1893); Laudon, Watsonia 5:61 (1961); Willis, Handb. Pl. Vict. 2:191 (1972); Curtis, Stud. Fl. Tasmania 1:184 (1975).

Type: Paraguay, Estancia de Jose Bermudes, near Monte Video, Commerson s.n. (LINN-SM, holo; BM; G, G-DC, microfiche!).

Tillaea peduncularis Sm. in Rees Cyclop. 35 (1817).

Crassula bonariensis Cambess., St. Hil. Flor. Brasil merid. 2 (39 Crassulaceae): 195 (1829); Webb in Fl. Europea 1: 351 (1964); Blackall, West. Austr. Wildflow. ed. Grieve 1: 178 (1954); Beard, Cat. West Austr. Pl. 36 (1965), nom. illeg.

Type: same as for *C. peduncularis*.

Tillaea purpurata Hook. f., Hooker's J. Bot. 6: 472 (1841); Fl. N. Zealand 2: 75 (1853); Fl. Tasm. 2: 145 (1860); Benth., Fl. Austr. 2: 451 (1864); Tate, Fl. S. Austr. 85 (1890); Bailey, Queensl. Pl. 169, fig. 142 (1913).

Crassula purpurata (Hook. f.) Domin, Bibl. Bot. 89: 704 (1925); Burbidge & Gray, Fl. A.C.T. 190 (1970); Beadle et al., Fl. Sydney Region 173 (1972).

Type: Tasmania, Formosa, Gunn 1967 (K, holo!).

Crassula pedicellosa sensu Beadle, Stud. Fl. NE NSW 2: 157, fig. 69C (1972), non (F. Muell.) Ostenf.

Annuals with short decumbent branches to 6 cm long and usually much branched. *Leaves* linear-lanceolate, (2-) 3-5 x 0.5-1 mm, cuspidate or acuminate, sometimes slightly constricted towards the base, dorsiventrally flattened and more or less convex on both

surfaces, green to deep red. *Inflorescence* with single terminal flowers in the axil of the leaves due to sympodial growth, with pedicels 3-8 (-10) mm long when fruiting; flowers 4-merous. *Calyx*: lobes broadly triangular, 0.7-1 mm long, obtuse rarely acute, glabrous, slightly fleshy, green to red. *Corolla* cup-shaped, white more or less tinged red; lobes oblong-triangular, 1.3-1.5 mm, obtuse, spreading. *Squamae* narrowly oblong, 0.4-0.6 x c. 0.1 mm, rounded, usually constricted towards the base, yellow. *Ovaries* obovoid, each abruptly constricted into short thin styles arising from the inner margin, with 10-14 ovules. *Follicles* smooth, recurving at the apex, splitting along the whole suture and opening up so widely that they are easily confused with the slightly smaller petals; seeds with fine vertical ridges. (Fig. 2, L & M).

Growing in marshy areas which are rarely flooded; occurring mainly in south-eastern Australia from the Eyre Peninsula to north-eastern New South Wales and in Tasmania but also a few scattered records from southern Western Australia. (Map 1). The species occurs also in New Zealand and South America.

A species with remarkably little variation. Fruiting specimens are easily identified by the very large and spreading margins of the membranous pericarp which can only be distinguished from the smaller petals by its usually emarginate apex and style rudiment. Marsh plants of *C. helmsii* superficially resemble flowering plants of *C. peduncularis*, but are distinguished by their long styles which are about half as long as and taper gradually into the ovary. Also, seeds of the former are more or less smooth while those of *C. peduncularis* have vertical ridges covered with tubercles.

According to descriptions the calyx lobes of plants from South America are acute while they are usually obtuse in Australia except for occasional records from New South Wales. Hence Laudon's suggestion to place the Australian species, *C. purpurata*, into the synonymy of *C. peduncularis*, was adopted here.

Selection of Specimens examined (79 seen)

WESTERN AUSTRALIA: *Eichler* 2007 F, 22 km N Stokes Inlet (AD); *Mueller* in MEL 90578, Stirling Ranges (MEL).

SOUTH AUSTRALIA: *Ising* in AD 97701103, Wudinna (AD); *Mueller* in MEL 90580, Mt Remarkable (MEL); *Weber* 1893, Big Heath National Park (AD); *Wilson* 645, Kelly Hill, Kangaroo Island (AD).

NEW SOUTH WALES (incl. A.C.T.): *Briggs* 2179, 5 km W Gungahlin (NSW); *Coveny* 5147, Tarloom Falls (NSW); *McBarron* 3479, Bulgandry Reserve (SYD).



Map 1. Distribution of *C. peduncularis*.

VICTORIA: *Beaublehole* 6665, Lady Julia Percy Island (MEL); *Beaublehole* 28488, Wyperfeld National Park (MEL); *Morrison s.n.*, Werribee, 24.x.1891 (AD, CANB, PERTH); *Wakefield* 3451, Cann River (MEL).

TASMANIA: *Mueller s.n.*, South Esk River (MEL, NSW); *Whinray* 877, Big Green Island (MEL); *Whinray* 1251, Mount Chappell Island (MEL).

3. *C. helmsii* (Kirk) Cockayne, Trans. N.Z. Inst. 39: 349 (1907); Burbidge & Gray, Fl. A.C.T. 190 (1970); Willis, Handb. Pl. Vict. 2: 191 (1972); Beadle, Stud. Fl. NE NSW 2: 157 (1972), pro parte excl. fig. 69B; Aston, Aquatic Pl. Aust. 67, fig. 24 (1973); Curtis, Stud. Fl. Tasm. 1: 185 (1975).

Types: New Zealand, near Greymouth, *Helms s.n.* (WELT!, lecto, designated here); Karamea, *Spencer* 30 (WELT!).

Tillaea helmsii Kirk, Stud. Fl. N.Z. 142 (1899); Allan, Fl. N.Z. 1: 198 (1961).

Tillaea verticillaris sensu Hook. f., Hooker's Icon. Pl. 3, pl. 295 (1840), non L.

Bulliarda recurva Hook. f., Hooker's J. Bot. 6: 472 (1847).

Tillaea recurva (Hook. f.) Hook. f., Fl. Tasm. 1: 146 (1860); Benth., Fl. Austr. 2: 452 (1862); Tate, Fl. S. Austr. 85 (1890); Bailey, Queensl. Fl. 159, fig. 143 (1913); Maiden & Betche, Census NSW 86 (1916); Black, Trans. R. Soc. S. Austr. 40: 63 (1916); 42: 45 (1918).

Crassula recurva (Hook. f.) Ostenf., Dansk bot. Ark. 2, 8: 46 (1918); Black, Fl. S. Austr. ed. 2: 392 (1948); Blackall, West. Austr. Wildflow. ed. Grieve 1: 178 (1954); Beard, Cat. West Austr. Pl. 36 (1965), non N.E. Br. (1890).

Type: Tasmania (Van Diemen's Land), *Gunn* 91 (K, holo!).

Annuals with decumbent branches to 12 cm long and often much branched in marsh plants, or floating branches to 25 cm long and occasionally branched. *Leaves* oblong-lanceolate to oblong-elliptic, 3-8 (-12) x (0.8-) 1-2 (-3) mm, acute to acuminate, rarely cuspidate, scarcely constricted towards the base, dorsiventrally flattened and slightly fleshy in marsh plants, green to brown. *Inflorescence* with one terminal flower in the axil of the upper leaves due to sympodial growth, with pedicels 4-7 mm long when fruiting; flowers 4-merous. *Calyx*: lobes triangular 0.6-0.8 (-1) mm long, bluntly acute to usually obtuse, glabrous, slightly fleshy, green. *Corolla* more or less cup-shaped, white; lobes lanceolate 1.6-2 mm, acute, spreading to somewhat recurved when flowering. *Squamae* oblong-cuneate 0.8-1 x 0.2-0.3 mm, truncate, gradually constricted towards the base, almost membranous, white. *Ovaries* obovoid to almost obconical but somewhat tapering into the styles, each with (2-) 4-10 ovules. *Follicles* smooth, slightly recurved, splitting along the whole suture but opening mainly into an apical pore; seeds smooth or with fine often incomplete vertical ridges. (Fig. 2, D & F).



Map 2. Distribution of *C. helmsii*.

Growing in or around standing water; occurring mainly in south-eastern Australia from near Adelaide in South Australia, through Victoria to north-eastern New South Wales and Tasmania. (Map 2). It also occurs in New Zealand and there are two old records from Western Australia.

The broader and acute to acuminate leaves of *C. helmsii* distinguish floating branches from those of the more delicate *C. natans*, apart from the fact that the latter has carpels similar in shape to those of *C. peduncularis*. Flowers of the latter two species are distinguished from those of *C. helmsii* by the ovary which is abruptly constricted into the short style.

Like all the species of *Crassula* which are tolerant to being submerged at times, *C. helmsii* varies between two extreme growth forms according to the conditions under which it grows. Firstly, submerged plants produce long branches that float on the surface of the water, and it is this form which is most commonly collected. The internodes are usually longer than 10 mm and the leaves are 2-3 mm broad. Secondly, when plants grow on moist soil they form small cushions with leaves densely clustered, up to 6 mm long and about 1 mm broad.

An interesting local variant was recorded from the Grampians and in particular from Mt Arapiles (*Beaglehole* 29792) in which the leaf apices are cuspidate to acuminate and young flowers are almost sessile, but shape of the carpel and seeds leave no doubt that this form should be placed into *C. helmsii*. Similarly plants from Tasmania tend to have leaves which are about 3 mm broad and have a cuspidate to mucronate leaf apex.

Of the two syntypes of *C. helmsii* the Helms's collection is not only a more complete specimen but also contains a note which explains that Baron von Mueller considered it to be a new species, which in turn might have been the motivation for Kirk to describe it. It is for these reasons selected as lectotype.

Selection of Specimens examined (219 seen)

WESTERN AUSTRALIA: *Drummond* in MEL 90816, Western Australia (MEL); *Grove* in MEL 90608, near Lake King (MEL).

SOUTH AUSTRALIA: *Eichler* 14896, Purnong Landing (AD, MEL); *Hunt* 1507, Comaum (AD); *Symon* 2061 (ADW, CANB); *Tate s.n.*, Kangaroo Island, 23.v.1880 (AD).

NEW SOUTH WALES (incl. A.C.T.): *Burbidge & Gray* 6219, Fitz Hill (CANB, NSW); *Coveny* 8797, Mt Kaputar National Park (NSW); *McBarron* 4420, Mulwala (SYD); *Sainty* in NSW 143702, Hanwood (NSW).

VICTORIA: *Beaglehole* 1606, Mt Arapiles (MEL); *Beaglehole* 21273, Port Campbell National Park (MEL); *Morrison* in CANB 133636, Port Melbourne (CANB); *Wakefield* 4269, Coringle (MEL).

TASMANIA: *Hannaford* in NSW 143689, Tamar River (NSW); *Morris* 7967, Sea Elephant River, Kings Island (HO); v. *Mueller* in MEL 90504, banks of Loddon River (MEL); *Whinray* 866, Big Green Island (MEL).

*4. *C. natans* Thunb., Prodr. 54 (1794); Fl. Cap. ed. Schultes 282 (1823); DC., Prodr. 3: 389 (1828); Toelken, Contr. Bolus Herb. 8: 86 (1977), Blackall, West. Austr. Wildflow. ed. Grieve 1: 179 (1959).

Type: Cape, near Cape Town, *Thunberg* in Herb. Thunberg 7772 (UPS, holo.!: G!; S!).

Although the typical variety is more widespread in South Africa and is usually common it has not been introduced into Australia.

Var. *minus* (Eckl. & Zeyh.) Rowley, Cactus Succ. J. Gt Brit. 40: 53 (1978).

Type: Cape, Green Point, *Ecklon & Zeyher* 1843b (S!; SAM!).

Helophytum natans (Thunb.) Eckl. & Zeyh. var. *minus* Eckl. & Zeyh., Enum. 288 (1837).

Crassula natans Thunb. var. *filiformis* (Eckl. & Zeyh.) Toelken, J1 S.Afr. Bot. 41: 112 (1975).

Type: Cape, Platte Klip, *Ecklon & Zeyher* 1850 (GRA!; K!; S!; SAM!).

Annuals with decumbent filiform branches to 10 cm long and often much branched when growing on marshy substrate, or slender floating branches to 25 cm long and rarely branched. *Leaves* linear, rarely linear-elliptic, 3-5 (-8) x 0.5-1 mm in marsh plants, or (5-) 6-12 (-14) x 1-1.5 (-2) mm in plants with floating branches obtuse to rarely acute when young, scarcely constricted towards the base, dorsiventrally flattened and slightly fleshy at least in marsh plants, green to pale reddish-brown. *Inflorescence* with one terminal flower (rarely two in marsh plants) in the axils of the leaves due to sympodial growth, with pedicels (2-) 3-5 mm long when fruiting; flowers 4-merous. *Calyx*: lobes broadly triangular 0.2-0.3 mm long, obtuse, glabrous, slightly fleshy, green to pale brown. *Corolla* more or less cup-shaped, white; lobes oblanceolate 0.6-0.8 mm long, acute to obtuse, spreading. *Squamae* oblong-cuneate 0.4-0.5 x 0.1-0.2 mm, truncate, first abruptly later gradually constricted towards the base, slightly fleshy, yellow or red. *Ovaries* obovoid to almost obconical, abruptly constricted into short styles, with one ovule. *Follicles* smooth, erect to slightly recurved, splitting and opening along the whole suture; seeds smooth and shiny or almost so. (Fig. 2, A-C).

Growing usually on marshy soil around standing water but occasionally plants are inundated; introduced from South Africa, where it is confined to the extreme SW Cape, to Perth and Adelaide but now recorded from many localities in southern Western Australia, and similarly now also from south-eastern South Australia and a few records from adjoining areas in Victoria and Tasmania. (Map 3).

The first specimen of the species was collected by *Sewell* (in MEL 90487) in 1883 from the vicinity of Perth. *Morrison* made several collections of the species from the same area between 1898 and 1902, but it is not known how quickly the species spread from there as no records exist until the late 1950's when the present distribution seems to have been attained.

Selection of Specimens examined (72 seen)

WESTERN AUSTRALIA: *Eichler* 19859, 14 km SW Howick Hill (AD, CANB); *Morrison* s.n., Cannington, 18.viii.1898 (BRI); *Toelken* 6422, Lake Logan (AD); *Willis* s.n., Balladonia (AD).

SOUTH AUSTRALIA: *Alcock* 2972, Big Heath National Park (AD); *Eichler* 19103, Uley Station Road (AD); *Phillips* 1055A, 18 km W of Flinders Chase National Park (CBG); *Spooner* 452, Torrens Gorge (AD).

VICTORIA: *Beaglehole* 6769, between Burnt Creek & Zumsteins (MEL); *Beaglehole* 21301 and 21547, Port Campbell National Park (MEL).

TASMANIA: *Whinray* 534, Badger Island (AD).



Map 3. Distribution of *C. natans*

B. sect. *Glomeratae* Haw., Rev. Pl. Succ. 12 (1821); Toelken, Contr. Bolus Herb. 8: 99 (1977).

Type: G. glomerata Berg.

Annuals herbs, rarely perennials. *Inflorescence* terminal and/or axillary thyrsoids each with 1-many dichasia. *Calyx* longer or as long as corolla, acute or pointed. *Carpels* with elongate ovaries gradually tapering into slender styles.

As in sect. *Helophytum*, the species of sect. *Glomeratae* have a world-wide distribution but most species occur in Southern Africa.

*5. *C. glomerata* Berg., Descr. Pl. Cap. 85 (1767); L., Mantissa 60 (1967); Schonl., Trans. R. Soc. S. Afr. 17: 187 (1929); Toelken, Contr. Bolus Herb. 8: 115 (1977).

Type: Caput Bonae Spei, Grubb s.n. (STB, holo!).

Annuals with stiffly erect branches to 15 cm high, more or less branched. *Leaves* oblong-lanceolate to oblong-elliptic 6-10 (-1.5) x 1-2 (-3) mm, subulate and often with a terminal seta, dorsiventrally compressed and slightly convex on both surfaces, green to brown. *Inflorescence* a terminal rounded or flat-topped thyrsoid often divided into several dense dichasia; pedicels usually absent, rarely to 4 mm long on the first flower of the inflorescence; flowers 5-merous. *Calyx*: lobes lanceolate 1-2.5 mm long, acute and each usually with a terminal point, glabrous, somewhat fleshy, green to brown. *Corolla* cup-shaped, white; lobes oblong-lanceolate, 1-1.6 mm long, obtuse or bluntly acute, recurved. *Squamae* oblong-cuneate, 0.4-0.5 x 0.2-0.3 mm, usually rounded, at first abruptly later gradually constricted downwards, almost membranous, pale yellow. *Ovaries* almost cylindrical and gradually constricted into distinct styles, with 2 ovules. *Follicles* tuberculate, erect, releasing lower seed by basal circumscissal split while upper one remains in hard pericarp; seed with faint or no vertical ridges. (Fig. 3, A-C).

Growing mainly in sandy soils in coastal areas; introduced from the coastal areas of the Cape Province, South Africa, to the vicinity of Perth but has now also been recorded from near Albany. Although it has been recorded from Sydney Botanic Gardens it does not seem to have become naturalized there.

Usually the flowers are sessile in dense dichasia but when plants grow in deep shade the inflorescence is loosely branched with the first flower often distinctly pedicellate. In such flowers the calyx usually elongates to twice the normal length. Also the size and in particular the width of the leaves varies greatly depending on the availability of moisture and shading.

Specimens examined

WESTERN AUSTRALIA: *Burbidge* 8090, Two People's Bay (CANB); *Cranfield s.n.*, Garden Island (PERTH); *Fitzgerald* in NSW 143676 & 7, Garden Island (NSW); *Lindgren s.n.*, Carnac Island (PERTH); *McArthur s.n.*, Garden Island (PERTH).

NEW SOUTH WALES: *Boorman* in NSW 143675, Sydney Botanic Gardens (NSW).

6. *C. pedicellosa* (F. Muell.) Ostenf., Dansk bot. Ark. 2, 8: 42 (1918); Black, Fl. S. Austr. ed. 2: 392, fig. 549B & D (1948); Beard, Cat. West Austr. Pl. 36 (1965); Willis, Handb. Pl. Vict. 2: 191 (1972).

Type: Western Australia, Sterling Mountains, Mueller in MEL 8845 (lecto.! selected here; MEL).

Tillaea macrantha Hook. f. var. *pedicellosa* F. Muell., Fragm. 11: 118 (1881); Black, Trans. R. Soc. S. Austr. 40: 63 (1916).

Tillaea pedicellosa (F. Muell.) F. Muell., Second Cens. 1: 84 (1889).

Annuals with erect branches to 10 cm long, usually little branched. *Leaves* oblance-

olate to elliptic 4-10 (-12) x (2-) 3-4 mm, obtuse, rarely acute, flat or slightly convex above and usually somewhat convex below, green to deep red. *Inflorescence* a condensed thyrsoïd, rarely several, usually with 2 or 3 dichasia sessile or almost so, pedicels to 30 mm long when fruiting; flowers 5-merous. *Calyx*: lobes lanceolate 1.5-2 mm long, acute and covered with blister-like papillae especially towards the apex, fleshy, green to red. *Corolla* cup-shaped, white to cream; lobes oblong-lanceolate, 1.8-2 mm long, acute, spreading. *Squamae* usually T-shaped, 0.3-0.4 x 0.6-0.7 mm, usually truncate to slightly rounded, abruptly constricted below the apex, somewhat fleshy towards the apex, pale yellow to white. *Ovaries* almost cylindrical and gradually constricted into distinct style, with 18-22 ovules. *Follicles* erect, smooth, releasing seeds through apical pores; seeds with faint vertical ridges. (Fig. 2, G & H).

Growing usually on sandy soils on lower slopes or on plains; occurring in the southern parts of Western Australia, southern South Australia and south-western Victoria, and also one record from Tasmania. (Map 4).

C. pedicellosa is very similar to *C. decumbens* but it is easily distinguished from the latter by its very short peduncles of the lateral branches of the dichasia so that the flowers appear to be arranged in an umbel. As the fruit matures the pedicels elongate very much more than in the latter species. The seeds of *C. pedicellosa* have vertical ridges while in *C. decumbens* these ridges are covered with tubercles.

Five sheets of what seems to be part of the type collection are found in von Mueller's herbarium, but only one of these bears the name '*Tillaea macrantha* var. *pedicellosa*' and this sheet No. 88451 is selected as a lectotype.

Selection of Specimens examined (75 seen)

WESTERN AUSTRALIA: *Chincock* 4104, 30 km N Naremben (AD); *Helms s.n.*, Frazer Range (AD, NSW); *Orchard* 1216, 13 km N Stokes Inlet (AD); *Trudgen* 2209, 13 km E Nanson (PERTH).

SOUTH AUSTRALIA: *Eichler* 19290, Bascombe Well (AD); *Kraehenbuehl* 2285, Tarnma (AD); *Spooner* 226, Torrens Gorge (AD); *Wilson* 648, Kelly Hill, Kangaroo Island (AD).

VICTORIA: *Aston* 1069, Mt Arapiles (MEL); *Beaughole* 49549, 14 km NW Anglesea (MEL); *Williamson s.n.*, Geelong (BRI, MEL).

TASMANIA: *Whinray* 184, Cape Barren Island.



Map 4. Distribution of *C. pedicellosa*.

7. *C. decumbens* Thunb. var. *decumbens*

C. decumbens Thunb., Prodr. 54 (1794); Fl. Cap. ed. Schultes 280 (1923); Schonl., Trans. R. Soc. S. Afr. 17: 183 (1929); Toelken, Contr. Bolus Herb. 8: 122 (1977).

Type: Cape, near Cape Town, Thunberg in Herb. Thunberg 7751 (UPS, lecto.! Toelken, 1977); BM! STB!).

Tillaea macrantha Hook. f., Hooker's Icon. Pl. pl. 310 (1841); Fl. Tasm. 1: 145 (1860); Benth., Fl. Austr. 2: 452 (1864); Tate, Fl. S. Austr. 85 (1890), as 'micrantha'; Black in Trans. R. Soc. S. Austr. 40: 63 (1916); Ostenf., Dansk. bot. Ark. 2, 8: 40 (1916); Maiden & Betche, Census NSW 86 (1916).

— *Crassula macrantha* (Hook. f.) Diels & Pritzel, Bot. Jb. 35: 210 (1904); Ostenf., Dansk. bot. Ark. 2, 8: 40 (1916); Black, Fl. S. Austr. ed. 2: 392 (1948); Blackall, West. Austr. Wildflow. ed. Grieve 1: 178, fig. (1954); Beard, Cat. West Austr. Pl. 36 (1965); Burbidge & Gray, Fl. A.C.T. 191 (1970); Beadle et al., Fl. Sydney Region 173 (1972); Curtis, Stud. Fl. Tasm. 1: 185, fig. 45 (1975).

Type: Tasmania (Van Diemen's Land), *Gunn s.n.* (K, holo.).

Tillaea macrantha Hook. f. var. *sepalosa* F. Muell., Fragm. 11: 117 (1881).

Type: S. Australia, between Venus and Streaky Bay, *H. Babbage s.n.* (MEL, holo.).

Crassula macrantha (Hook. f.) Diels & Pritzel var. *nuda* Ostenf., Dansk. bot. Ark. 2, 8: 41 (1916).

Syntypes: Western Australia, near Perth, *Davis sub Ostenfeld 1349* (NSW!); Near Armadale, *Ostenfeld 358* (MEL!); *359* (NSW!; PERTH!); *362*; at Mundaring Weir, *Ostenfeld 363*.

Annuals with erect or decumbent branches (0.5-) 3-9 (-12) cm long, rarely tufted, usually repeatedly branched. Leaves linear-lanceolate to linear-elliptic, 3-8 (-10) x (0.8-) 1-2 mm, usually acute, slightly constricted towards the base, dorsiventrally compressed and more or less convex on both surfaces, fleshy, green to reddish-brown. Inflorescence one to several elongate leafy thyrsoids often with several pairs of lateral dichasia, with pedicels to 8 mm long when fruiting; flowers 5-merous. Calyx: lobes lanceolate 1.5-2.5. (-3.5) mm long, acute, glabrous or rarely with a few terminal papillae, fleshy, green to pale brown. Corolla cup-shaped, white to cream; lobes lanceolate 1.5-2 mm long, acute, spreading. Squamae broadly wedge-shaped to T-shaped, 0.2-0.4 x 0.4-0.7 mm, usually truncate, first abruptly constricted later more gradually tapering towards the base, slightly thickened at the apex, pale yellow to white. Ovaries elongate-reniform in profile and gradually constricted into a thin style, with 4-12 ovules. Follicles smooth, slightly recurved, releasing seeds through broad apical pore; seeds with vertical ridges covered with tubercles. (Fig. 2, J & K).

Growing usually in moist places but often in different habitats varying from coastal dunes to mountain slopes; occurring in south-western Western Australia, southern South Australia, widespread in Victoria and south-eastern New South Wales also found in Tasmania as well as in the south-western Cape, South Africa. (Map 5). The var. *brachyphylla* is restricted to the coast of the south-western Cape Province.

The wide range of variation occasionally found in this species is particularly striking because most of the plants vary little as they tend to grow in similar positions. Occasionally plants grow in wet areas in deep shade and as expected all the organs are then enlarged including the bracts and pedicels so that the flowers appear to be axillary. Also unusual is the calyx which may be at least twice as long as the corolla.

On the other hand plants growing under unfavourable conditions may consist of a single branch about 10 mm long with one or two flowers, as plants start flowering from their third node above the cotyledons (see inflorescences). A few papillae or teeth may at times be found along the margin of the sepals but cilia, as Hooker's original description of *C. macrantha* may suggest, have never been observed.

C. macrantha was included in the synonymy of *C. decumbens* despite the more pointed tubercles in typical material from South Africa. In Western Australia, however, the tubercles are much more like those in South Africa.



Map 5. Distribution of *C. decumbens* var. *decumbens*.

Selection of Specimens examined (332 seen)

WESTERN AUSTRALIA: *Moore s.n.*, Merredin (CANB); *Morrison* in BRI 156756, Hotham River, Marradong (BRI); *Toelken* 6494, Phillips River near Ravensthorpe (AD); *Willis* in MEL 90485, Boxer Island (MEL).

SOUTH AUSTRALIA: *Alcock* 1636, Lincoln National Park (AD); *Black s.n.*, Campbell's Creek, Melrose (AD); *Hunt* 1100, 10 km W Naracoorte (AD); *Jackson* 145, Reeve's Point, Kangaroo Island (AD).

NEW SOUTH WALES (incl. A.C.T.): *Bradley* in NSW 143790, S. Mosman (NSW); *McBarron* 2110, Albury (NSW); *McBarron* 4966, Coreen (SYD); *Rodway* 2802, Huskisson (NSW).

VICTORIA: *Aston* in MEL 90999, Mt Eccles (MEL); *Melville* 864, 2 km Kaniva (MEL); *Moore* in CANB 50494, Yarrawonga (CANB); v. *Mueller* in MEL 90764a, Campaspe River (MEL).

TASMANIA: *Gunn* 1117, George Town (NSW); *Hannaford* 21, Hobart (NSW); *Whinray* 519, Mt Chappell Island (AD); *Whinray* 53, Lady Barron, Flinders Island (MEL).

*8. *C. thunbergiana* J.A. Schultes subsp. *thunbergiana*

Crassula thunbergiana J.A. Schultes, Syst. Veg. 6: 733 (1820); Toelken, Contr. Bolus Herb. 8: 117 (1977).

Type: Cape, *Thunberg* in Herb. Thunberg 7750a (UPS, lecto.! (Toelken, 1977); G!).

Annuals with decumbent branches to 8 cm long and usually much branched. *Leaves* linear-lanceolate or linear-elliptic, 2-6 (-8) x 0.8-1.5 mm, with acute but usually blunt apices covered with blister-like papillae at least when young, flat on top and strongly convex below, fleshy, green to reddish-brown. *Inflorescences* one to several elongate leafy thyrsoids with sessile dichasia in the axils of the leaves, with pedicels (0-) 1-3 mm long; flowers 5-merous. *Calyx*: lobes lanceolate 1-2 (-3) mm long, bluntly acute and usually more or less covered with blister-like papillae, fleshy, green to brown. *Corolla* cup-shaped, cream, sometimes tinged red; lobes lanceolate c. 1 mm long, sharply acute and often folded lengthwise, spreading. *Squamae* T-shaped, 0.2-0.3 x 0.1-0.3 mm, truncate or slightly rounded, almost membranous, white to red. *Ovaries* elongate-reniform in profile, more or less abruptly constricted into thin style, with 2 ovules. *Follicles* erect, slightly papillose mainly towards the base, releasing upper seed through apical pore, while lower one remains enclosed in the pericarp which is shed by basal circumscissile split; seeds with vertical rows of tubercles. (Fig. 3, O-Q).

Usually growing in sandy soils in gardens or in disturbed areas; probably originally introduced to the vicinity of Perth from where the earliest records were made but now

also from near Albany. It grows naturally on the western Cape coast in South Africa while the subsp. *minutiflora* occurs in the north-western arid areas of the Cape Province and south-western Namibia.

C. thunbergiana is very similar to some forms of *C. sieberana* subsp. *tetramera* and especially the fruits are almost indistinguishable. The latter species is, however, distinguished by its 4-merous flowers with acute calyx lobes often ending in a colourless awn. In both species the calyx lobes may be considerably elongated where plants grow in favourable or under shady conditions.

Specimens examined

WESTERN AUSTRALIA: *Eichler* 16037, Middleton Beach (AD); *Fitzgerald s.n.*, Cottesloe (NSW); *Royce* 3927, Hamelin Bay (PERTH); *Toelken* 6439, King's Park (AD); *Turvey* in NSW 143671, Melville (NSW).

9. *C. sieberana* (J.A. & J.H. Schultes) Druce, Rep. botl. Soc. Exch. Club Br. Isl. 1916: 704 (1917).

Type: Nova Hollandia, *Sieber* 173 (M, holo!; G-DC, microfiche!; K; MEL!).

Perennials or annuals with erect or decumbent branches to 20 cm long, more or less branched. *Leaves* linear-lanceolate (3-) 4-8 (-11) x 1-3 mm, acute to obtuse, usually flat above and more or less convex below, fleshy, green to greyish-brown rarely reddish-brown. *Inflorescence* one to several elongate thyrsoids, rarely panicles, usually with many pairs of dichasia sessile in the axils of the leaf-like bracts, with pedicels 1-10 mm long when fruiting; flowers 4-merous. *Calyx*: lobes lanceolate to linear-lanceolate 1.5-3 mm long, acute and usually with a colourless terminal point and sometimes with papillae, often very fleshy, green to pale brown. *Corolla* cup-shaped, pale yellow to red; lobes lanceolate 1-2 mm long, sharply acute and often folded lengthwise, erect to spreading. *Squamae* linear-cuneate to oblong-T-shaped, 0.4-0.6 x 0.1-0.2 mm, more or less truncate, slightly fleshy at the apex, white or pale yellow. *Ovaries* almost cylindrical to almost conical and gradually constricted into styles, with 2 ovules. *Follicles* often slightly papillose, splitting along the whole suture but usually opening into an apical pore and often also with basal circumscissal split; seeds almost smooth, with faint ridges or rarely with small tubercles.

The typical subspecies is restricted to the mountainous areas of eastern Australia while subsp. *tetramera* occurs widely in temperate and arid regions of Australia.

The type specimen (in M) is probably the holotype because it is from Schultes herbarium and shows the decumbent habit and adventitious roots mentioned in the original diagnosis. These characteristics are not visible in other specimens of the type collection investigated.

9a. subsp. *sieberana*

Tillaea sieberana J.A. & J.H. Schultes, Mant. 3: 345 (1827); Allan, Fl. N.Z. 1: 199 (1961).

Crassula sieberana (J.A. & J.H. Schultes) Druce, Rep. botl. Soc. Exch. Club Br. Isl. 1916: 704 (1917); Domin Bibl. Bot. 89: 704 (1925) pro parte, *C. adscendenti*, *C. colorata* excl.; Ising in Trans. R. Soc. S. Aust. 61: 222 (1937); Burbidge & Gray, Fl. A.C.T. 190 (1970); Beadle, Stud. Fl. NE N.S.W. 157 (1972); Beadle et al., Fl. Sydney Region 173 (1972); Curtis, Stud. Fl. Tasm. 1: 184 (1975).

Tillaea verticillaris DC., Prodr. 3: 382 (1828); Hook. f., Fl. Tasm. 1: 145 (1860); Benth., Fl. Austr. 2: 451 (1862); pro parte, *T. adscendenti* et *T. colorata* excl.; F. Muell., Sec. Cens. 1: 83 (1889), pro parte; Tate, Fl. S. Austr. 85, 229 (1890); pro parte; Bailey, Queensl. Fl. 169, fig. 141 (1913); Maiden & Betche, Census N.S.W. 86 (1916).

Type: same as for *T. sieberana*.

C. helmsii sensu Beadle, Stud. Fl. NE N.S.W. 2, fig. 69B (1972) pro parte, descr. excl.; non (Kirk) Cockayne.

Perennials, rarely annuals, with decumbent branches and usually with adventitious roots. *Branches* carnose, with swollen nodes at least where without leaves and with basal internodes (1-) 3-5 (-8) mm long. *Follicle* releasing seeds through apical or lateral slit or pore, rarely shedding dark brown pericarp by basal circumscissal split. (Fig. 3, F-H).

Growing in crevices on wet rocks in mountains usually with an average yearly rainfall exceeding 600 mm; occurring in mountains in eastern Australia with few records from South Australia but common in Victoria, eastern New South Wales and south-eastern Queensland as well as Tasmania, Lord Howe Island and New Zealand. (Map 6).

Plants of the two subspecies often grow close to one another but in the field they could always be identified as one or the other subspecies by their individual habitat. Also well preserved specimens present no difficulty but when one tries to identify fragments without basal parts of the plants it becomes difficult to distinguish between the subspecies. Shade forms of subsp. *sieberana* may also cause some problems as their internodes elongate excessively and the whole soft plant has the appearance of an annual. To add to the problems plants of subsp. *tetramera* under similar conditions will develop soft branches, the whole plant becoming decumbent and much branched so that these plants appear to be similar to shade plants of subsp. *sieberana*. For these reasons some specimens, particularly from Tasmania, cannot be identified with certainty.

Much more robust plants have been recorded from near Nerriga (*Pickard* 3319) but unless a wider range of material becomes available or the population can be investigated in the field one hesitates to describe a new taxon in a variable species like this. Even the seeds show considerable variation in the size and number of tubercles on the seed testa.

Selection of Specimens examined (240 seen)

QUEENSLAND: *Keys* in BRI 244985, Mount Perry (BRI); *McDonald & Stanley* in BRI 225432, Lamington National Park (BRI); *White* 8609, Mt Ernest (BRI); *White* in BRI 244983 (BRI).

SOUTH AUSTRALIA: *Cleland* in AD 97209149, waterfall of Inman Valley (AD); *Cleland* in AD 97209158, Encounter Bay (AD); *Toelken* 6546, Hindmarsh waterfall (AD).

NEW SOUTH WALES (incl. A.C.T.): *Blake* 2529, Sydney (BRI); *Cambage* in BRI 245001, Torrington (BRI); *Constable* in NSW 30971, Narrabarka Creek (NSW); *Johnson* 348/62, Kowmung River (NSW); *Pickard* 2746, Lord Howe Island (NSW).

VICTORIA: *Beaughlehole* 22500, Mt Fainter (MEL); *Briggs* 2899, McKenzie Falls (NSW); *Morton* in MEL 513258, Belgrave Height (MEL); *H.C.E. Stewart* in BRI 245019, Mt Buffalo (BRI).

TASMANIA: *Curtis* in HO 30032, near Kingston (HO); *Gordon* in HO 15321, near Neika (HO); *Whinray* 786, Craggy Island (MEL).



Map 6. Distribution of *C. sieberana* subsp. *sieberana*.

9b. subsp. *tetramera* Toelken subsp. nov.

Ab subsp. *sieberana* ramis erectis, non carnosis et habitu annuo differt; similis *C. thunbergianae* sed floribus tetrameris et calicis lobis acutissimis differt.

Type: Northern Territory, Simpson's Gap National Park, Latz 4286 (AD, holo!, CANB!, NT!).

Annuals with erect rarely decumbent branches to 15 cm long, without adventitious roots; branches wiry-woody, not articulated and with basal internodes (4-) 8-12 (-20) mm long. *Follicles* releasing upper seed through apical pore while the lower seed is shed (still enclosed in the pale brown pericarp) by a basal circumscissal split. (Fig. 3, J-L).

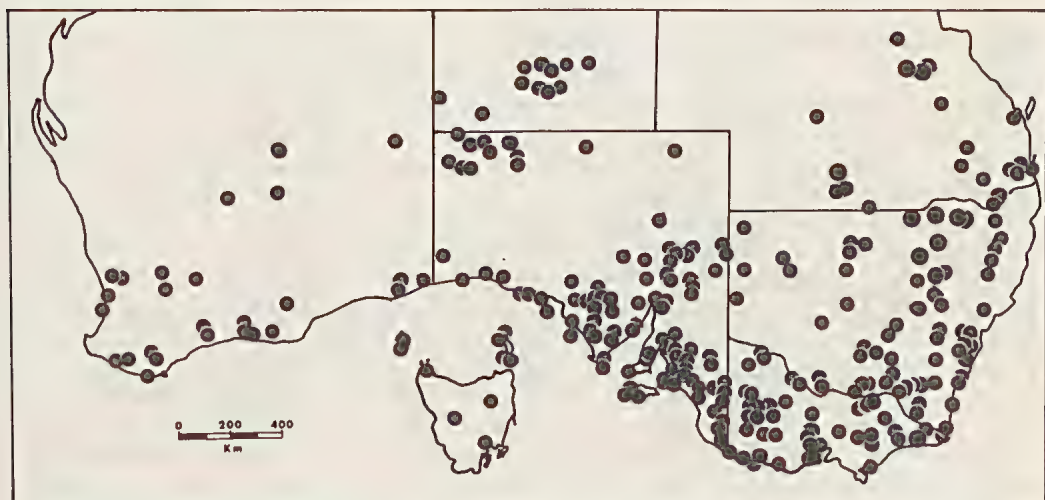
Growing in a wide range of habitats but usually somewhat sheltered either among rocks or in partial shade of trees or shrubs; widespread in temperate to subtropical areas of Australia including the eremaeic region but with only a few records from central Western Australia south of the 26° latitude and more common in the coastal areas to the south and south-west; occasionally in rock outcrops or mountains in the Northern Territory south of the 23° latitude; a few scattered records throughout southern but mainly in south-eastern Queensland; more or less common throughout South Australia, Victoria and New South Wales except in the north-eastern coastal areas; few records throughout Tasmania. (Map 7).

Plants with a more decumbent habit are superficially similar to *C. thunbergiana* particularly when one considers the close resemblance of the fruits and the mode of seed dispersal. The flowers of subsp. *tetramera* are, however, 4-merous and have sharply acute calyx lobes which often end in a colourless point.

The calyx is usually twice as long as the corolla in plants from the coastal areas and here the habit is usually also rigidly erect while plants from the more arid areas tend to start off with an erect habit but often become decumbent later, and the calyx tends to be rarely much longer than the corolla. Both these characters seem to be ecologically induced as some individuals as well as some collections show a range of intermediates, e.g. Weber 3066, Cleland s.n. (21.ix.1968).

Selection of Specimens examined (520 seen)

WESTERN AUSTRALIA: Eaton in MEL 90751, Swan River (MEL); Keighery 1231, Mt Hassell, Stirling Ranges (PERTH); Toelken 6079, 65 km NNW Leonora (AD); Wilson 10044, Condungup Hill, 65 km E Esperance (PERTH).



Map 7. Distribution of *C. sieberana* subsp. *tetramera*.

NORTHERN TERRITORY: *Henry 1012*, Mt Alooarjara (BRI, CANB, NT); *Latz 4190*, Dean Range (AD, CANB); *Perry 5481*, 56 km SW Alice Springs (CANB); *Schodde 394*, Ayers Rock (AD, CANB).

QUEENSLAND: *Blake 19077*, W. Millmerran (BRI); *Carolyn 4028*, Boorara Station, N Hungerford (SYD); *Henderson et al. 839*, 32 km SE Blackwater (CANB, BRI, MEL); *Walker* in BRI 71668, Maryborough (BRI).

SOUTH AUSTRALIA: *Barker 2893*, Tjatamanuga rockhole (AD); *Beaulehole 19451*, 15 km W Penola (AD); *Lothian 4730*, Pedirka (AD); *Toelken 6001*, 2 km W Yatala Roadhouse (AD).

NEW SOUTH WALES (incl. A.C.T.): *Bailey* in NSW 143819a, Gilgandra (NSW); *Hoogland 10041* (CANB); between Nerriga & Nowra (CANB); *Hotchkiss 498*, Piangobla (SYD).

VICTORIA: *Beaulehole 21060*, Port Campbell National Park (MEL); *Muir 162*, Warby Ranges (MEL); *Wakefield 3450*, Mt Raymond (MEL); *Willis* in MEL 91052, Sturt Highway, 12 km E South Australian border (MEL).

TASMANIA: *Hannaford* in NSW 143653, Hobart Town (NSW); *Phillips* in CBG 030535, Ocean Beach, Shaban (CBG); *Whinray 54f*, Flinders Island (MEL); *Whinray 761*, Little Dog Island (MEL).

10. *C. exserta* (Reader) Ostenf. Dansk. bot. Ark. 2, 8: 48 (1918); Willis, Handb. Pl. Vict. 2: 192 (1972); Curtis, Stud. Fl. Tasm. 1: 184 (1975).

Type: Victoria, Dimboola shire, Lowan, *Reader* in MEL 90891 (MEL, holo.).

Tillaea exserta Reader, Vict. Nat. 14: 83 (1897); Ewart et al, J. R. Soc. N.S.W. 42: 196, t.35 (1908).

C. sieberana J.A. & J.H. Schult. var. *exserta* (Reader) Domin, Bibl. Bot. 89: 704 (1925).

Annuals with erect stems to 15 cm long, little branched and mainly from the base. *Leaves* lanceolate 1.5-3 x 1-2 mm, obtuse, rarely acute, slightly constricted towards the base, flat or almost so above and strongly convex below, fleshy, glabrous to rugose, green to deep red. *Inflorescence* one, sometimes several thyrsoids, rarely panicles, with sessile dichasia in the axils of leaf-like bracts, with pedicels 0.5-2.5 (-5) mm long when fruiting; flowers 5-merous. *Calyx*: lobes lanceolate 1-1.3 mm long, pointed, fleshy, green to red but with colourless terminal point. *Corolla* cup-shaped, scarcely fused at the base, white to red; lobes linear-lanceolate, 0.8-1 mm long, sharply acute, spreading. *Squamae* linear, 0.4-0.5 x c. 0.1 mm, rounded to truncate, scarcely constricted towards the base, slightly fleshy, white. *Ovaries* almost cylindrical, abruptly constricted into short styles, with 2 ovules. *Follicles* erect, papillose to tuberculate, releasing seeds through large apical pore but lower seed usually retained as pericarp breaks off only after the calyx, which is clasping the follicles, has decayed; seeds smooth or almost so. (Fig. 3, D & E).



Map 8. Distribution of *C. exserta*.

Growing usually on sandy clay in low-lying areas often together with *C. colorata* and/or *C. sieberana* subsp. *tetramera*; few scattered records from southern Australia exist from south-western and southern Western Australia, from the Eyre Peninsula and southern Murraylands in South Australia and western Victoria, as well as one record from Flinders Island, Tasmania. (Map 8).

In the fruiting stage the ovaries seem to be much longer than the other floral parts but this is due to folding inwards of the calyx lobes so that they are situated between the carpels, a character which can also often be observed in *C. colorata*. Some specimens do not develop these characteristics and can only be distinguished from *C. thunbergiana* by the very pointed calyx lobes and from *C. sieberana* by the 5-merous flowers of *C. exserta*.

From the time Reader collected the first specimen (6.xi.1892) to the final publication of the species, he continued to collect specimens of the species, corresponded with Mueller, and drew up and refined a description. However, it is not clear from the correspondence what material he used at which stage. Of the six sheets now in Melbourne Reader's first collection (MEL 90891) must be taken as a designated holotype similar to that of *C. acuminata* Reader. This unfortunate choice of a depauperate specimen must be adhered to because he did not cite another specimen in the protologue or even give an indication that plants were collected after 1892 as he did for *Prasophyllum fuscoviride* Reader, l.c. p. 163.

Selection of Specimens examined (30 seen)

WESTERN AUSTRALIA: *Jackson 1368*, 80 km WNW Esperance (AD, CANB, PERTH); *Oldfield* in MEL 90550, Tom River (MEL); *Orchard 1335*, Wittenoom Hills (AD, CANB); *Toelken 6421*, Lake Logan (AD).

SOUTH AUSTRALIA: *Blackburn* in ADW 10376, Tintinara (ADW); *Ising* in AD 966031032, Arno Bay, (AD); *Wheeler 775a*, Hincks National Park (AD).

VICTORIA: *Reader* in MEL 90891, near Dimboola (MEL); *Reader* in MEL 90492, Oakgrove, Little Desert (MEL); *Sullivan* in MEL 90902, plains near Mt William (MEL).

TASMANIA: *Sutton* in MEL 90493, Flinders Island (MEL).

11. *C. colorata* (Nees) Ostenf., Dansk bot. Ark. 2, 8: 46 (1918), Black, Fl. S. Austr. ed. 2, 391, fig. 549 A-C (1948); Blackall, West. Austr. Wildflow. ed. Grieve 1: 178, fig. (1954); Beard, Cat. West Austr. Pl. 36 (1965); Willis, Handb. Pl. Vict. 2: 192 (1972).

Type: Western Australia, near Perth, *Preiss 1932* (LD!; MEL!; S!).

Tillaea colorata Nees, in Lehm., Pl. Preiss. 1: 277 (1844-5).

Tillaea verticellaris sensu Benth., Fl. Austr. 2: 451 (1864), pro parte; sensu F. Muell., Second Cens. 1: 83 (1889), pro parte; Tate, Fl. S. Austr. 85, 229 (1890), pro parte quoad *T. colorata*.

Annual with usually erect stems to 15 cm long, little branched and mainly from the base. *Leaves* lanceolate 2-4 (-6) x 1.5-3 (-4) mm, obtuse or rarely acute, slightly but abruptly constricted towards the base, flat to slightly convex above, more or less convex below, green to reddish-brown. *Inflorescence* one, sometimes several thyrsoids, rarely panicles, with sessile dichasia in the axils of leaf-like bracts, with pedicels usually absent or rarely up to 1 mm long when fruiting, flowers 5-merous. *Calyx*: lobes triangular to lanceolate, 1-2.5 mm long, acuminate, fleshy, green to red. *Corolla* cup-shaped, pale yellow to red; lobes lanceolate, 1-2 mm long, acuminate to cuspidate, often slightly folded along the middle, spreading. *Squamae* linear, 0.5-0.7 x 0.1-0.2 mm, rounded, slightly constricted downwards, slightly fleshy, pale yellow. *Ovaries* pyriform to almost cylindrical and gradually constricted into slender styles, with 2 ovules. *Follicles* erect, smooth to tuberculate, releasing seeds when broken off by basal circumscissal split; seeds usually faintly ridged.

Although some variation is found in the follicles of the different varieties no intermediates between them have as yet been recorded. Several mixed collections of var.

colorata and var. *tuberculata* from various parts of their common distribution area exist and in all of these collections specimens of the latter are more numerous. It is not known whether the two varieties can be crossed. If so, it is not a simple dominant recessive relation as the percentage presence of var. *tuberculata* varies from 50-70%.

10a. var. *colorata*

Tillaea colorata Nees in Lehm., Pl. Preiss. 1: 277 (1844-5); Black, Trans. R. Soc. S. Aust. 42: 77 (1918).

Crassula colorata (Nees) Ostenf., Dansk. bot. Ark. 2, 8: 46 (1918).

Tillaea intricata Nees, in Lehm., Pl. Preiss. 1: 278 (1844-5).

Crassula intricata (Nees) Ostenf., Dansk. bot. Ark. 2, 8: 46 (1918).

Type: Western Australia, Rottnest Island, Preiss 1929 (LD!; MEL!; S!).

Tillaea adscendens Nees in Lehm., Pl. Preiss. 1: 277 (1844-5).

Type: Western Australia, Fremantle, Preiss 1931 (LD!; MEL!; S!).

Follicles laterally compressed, slightly constricted at the base, gradually constricted into slender styles, smooth, membranous, usually pale. (Fig. 3, U).

Restricted to the coastal areas where it occurs in a wide range of habitats; found commonly in southern Western Australia, sporadically in southern South Australia and few records in south-western Victoria. (Map 9).

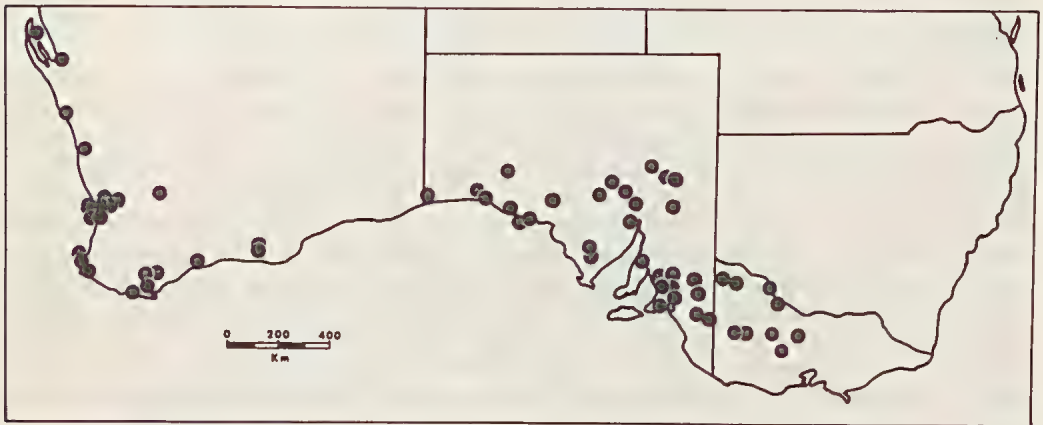
Sometimes the epidermal cells on the follicle are bulging and may be blister-like, but this cannot be confused with the tubercles on mature fruits of var. *tuberculata*, where they are usually restricted to one area. Usually the follicles remain attached to the plant for some time but occasionally, particularly in var. *colorata*, they are lost shortly after the plant matures, e.g. *F. Mueller* in MEL 90554.

Selection of Specimens examined (90 seen)

WESTERN AUSTRALIA: *Keighery* 420, 45 km E Lake King (PERTH); *Keighery* 457, Cape le Grand National Park, Hellfire Bay (PERTH); *Ostenfeld* 360, Yallingup Caves (MEL); *Mueller* in MEL 90554, Hamelin Pool, Shark Bay (MEL).

SOUTH AUSTRALIA: *Cleland* in AD 97209145, Kinchina (AD); *Eichler* 12471, Koonamore (AD); *Toelken* 6000, 2 km W Yalata Roadhouse (AD); *Wheeler* 687, Hincks National Park (AD).

VICTORIA: *Beaulehole* 28554, 7 km NW Dimboola (MEL); *Luehmann* in MEL 90852, Swan Hill (MEL); *Perry* in MEL 530698, Western Whipstick (MEL).



Map 9. Distribution of *C. colorata* var. *colorata*.

10b. var. *miriamiae* (Ostenf.) Toelken, stat. nov.

Crassula miriamiae Ostenf., Dansk bot. Ark. 2, 8: 43 (1918).

Type: Western Australia, near Perth, Davis sub *Ostenfeld 1452* (MEL1).

Follicles almost spherical, scarcely constricted towards the base and abruptly constricted into the short erect styles, smooth, membranous, pale. (Fig. 3, T).

Recorded from low-lying areas near Perth and the Stirling Ranges.

Ostenfeld compared this taxon with *C. sieberana* but it is much closer to and at times almost indistinguishable from var. *colorata* (cf. *Cronin* in MEL 90844). The smooth follicles of the latter are often also somewhat inflated but never abruptly constricted into a short style. Ostenfeld also stresses the relatively short follicles which are shorter than the sepals. They are also often shorter than the other varieties, but appear to be much longer than the calyx because the lobes curve inwards so that their length is deceptive (cf. *C. exserta*).

Specimens examined

WESTERN AUSTRALIA: *Mueller* in MEL 90636, Stirling Ranges (MEL).

11c. var. *tuberculata* Toelken, var. nov.

Ab var. *colorata* folliculis tuberculis differt.

Type: Western Australia, 65 km Leonora, *Toelken 6079* (AD, holo.).

Tillaea acuminata Reader, Vict. Nat. 15: 96 (1898); Black, Trans. R. Soc. S. Aust. 40: 63 (1916).

T. sieberana J.A. & J.H. Schultes var. *acuminata* (Reader) Ewart et al., J. Proc. R. Soc. N.S.W. 43: 196 (1908).

Crassula sieberana (J.A. & J.H. Schultes) Druce var. *acuminata* (Reader) Domin, Bibl. Bot. 89: 704 (1925).

Type: Victoria, Dimboola shire, Lowan, *Reader* in MEL 89418a (MEL, holo.!).

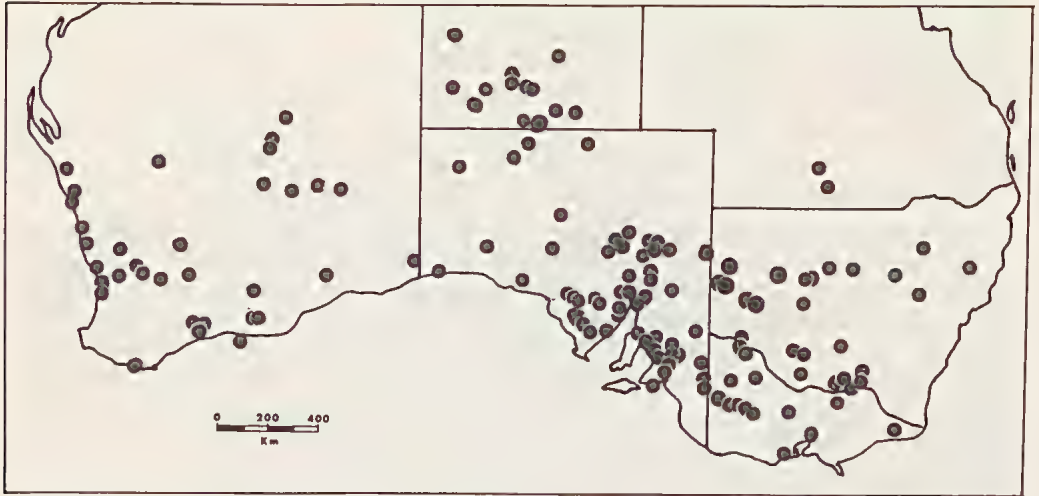
C. colorata sensu Burbidge & Gray, Fl. A.C.T. 190 (1970); sensu Beadle, Stud. Fl. NE N.S.W. 157 (1972), non (Nees) Ostenf.

Follicles almost cylindrical and slightly laterally compressed, abruptly constricted in the lower third and gradually constricted into a slender style, with a cluster of crustaceous brown tubercles in the lower third but otherwise membranous. (Fig. 3, R & S).

Growing in a wide range of habitats often together with *C. sieberana* subsp. *tetramera*; widespread but rarely collected in some areas of Australia including the southern temperate areas as well as much of the eremaeic regions of Western Australia, south of the 22° latitude in Northern Territory, most parts of South Australia, with few records from south-central Queensland and mainly in areas west of dividing mountains of New South Wales and Victoria. (Map 10).

The calyx lobes are tightly clasping around the follicles, with the tubercles present just below them so that the follicles are retained in position often for several years. Even after heavy rains remains of old plants with many fruits still intact were found in some areas, e.g. *Toelken 6004*. Particularly in the south-western parts of Western Australia the styles plus the upper part of mature fruits are often strongly recurved, so that the plants look superficially similar to those of *C. exserta*. However, the distinctive profile of the individual follicles and specifically the tubercles on them leave no doubt that they must be identified as var. *tuberculata*.

Plants from eastern South Australia and north-western Victoria have mature follicles which are often rather broad and scarcely constricted towards the base. Mature fruits show the distinctive tubercles on the side of each follicle as for instance in *Beaglehole 30944*.



Map 10. Distribution of *C. colorata* var. *tuberculata*.

Selections of Specimens examined (206 seen)

WESTERN AUSTRALIA: *Chinnock* 4102, 30 km N Naremben (AD); *Helms* s.n., Mt Squires (MEL, NSW); *Toelken* 6253, 26 km ENE Carnegie HS (AD); *Willis* in MEL 90546, Boxer Island (MEL).

NORTHERN TERRITORY: *Beauglehole* 20521, Bagot Creek (NT); *Latz* 4123, Ayers Rock (AD); *Tate* in AD 97617608, Macdonnell Range (AD).

QUEENSLAND: *Carolyn* 4028a, Boorara Station (SYD); *Everist* 1635, Cunnamulla (BRI).

SOUTH AUSTRALIA: *Cleland* in AD 97209148, Ooldea Soak (AD); *Ising* 2307, Kinchina (AD); *Lothian* 810, De Rose Hill Station (AD); *Weber* 2204a, 5 km W Brougham's Cottage (AD).

NEW SOUTH WALES: *McBarron* 1214a, Holbrook (SYD); *Crisp* 4082, Bundella Station (CBG); *Milthorpe & Cunningham* 1343, Fowler's Gap Station (NSW); *Officer* in NSW 143822, Zara, Wanganella (NSW).

VICTORIA: *Beauglehole* 28260, Wyperfeld National Park (MEL); *Beauglehole* 38452, Dimboola (MEL); *Pyre* in MEL 90880, Lower Goulburn River (MEL); *Robbins* 42247, Hepburn Hill (MEL).

*12. *C. alata* (Viv.) Berger var. *alata*

Crassula alata (Viv.) Berger, Pflanzenfam. ed. 2, 18a: 389 (1930); Wickens & Bywater, Kew Bull. 34: 633, 4 (1980).

Type: Egypt, near Kahirum, *Viviani* s.n. (GE?, holo.).

Tillaea alata Viv., Pl. Aegypt. Dec. 4: 16 (1830).

Crassula tripartita N.A. Wakefield, Vict. Nat. 73: 186 (1957); Willis, Handb. Pl. Vict. 2: 192 (1972).

Type: Victoria, Rutherglen, G.A. Morrow s.n. (MEL, holo.).

Annuals with erect stems to 5 cm long, little branched. *Leaves* linear-lanceolate to linear, 1.5-2.5 (-3) x 0.5-0.8 mm, acute and often with a colourless point, flat or almost so above, but usually strongly convex below, green to reddish-brown. *Inflorescence* one, rarely a few, thyrsoids with sessile dichasia in the axils of leaf-like bracts, with pedicels absent or almost so; flowers 3-merous. *Calyx*: lobes oblong-lanceolate 1.5-2 mm long, acuminate to cuspidate with colourless point; fleshy, green to red. *Corolla* cup-shaped, off-white often tinged red; lobes triangular, 0.7-1 mm long, usually cuspidate, erect. *Squamae* oblong-cuneate to almost square, 0.2-0.5 x c. 0.2 mm, rounded, slightly broadened at the apex, membranous, pale yellow. *Ovaries* almost conical, at first gradually later abruptly constricted into short styles, with 2 ovules. *Follicles* erect, smooth, splitting along the whole suture but opening only in the upper half and breaking off at the base by a circumscissal split; seeds with faint vertical ridges.

Growing in shallow soil on surface rocks or in crevices in masonry; introduced from the eastern Mediterranean area to suburbs of Perth and Adelaide, but also recorded from near Hamilton (Victoria) and Walbundrie (New South Wales).

C. alata is often included in the synonymy of *C. tillaea* Lester Garl. but recent workers have tended to keep the two taxa separate (Wickens & Baywater, 1980).

Specimens examined

WESTERN AUSTRALIA: *Keighery 1175*, Kings Park (PERTH); *Wheatley s.n.*, Harvey Bowling Club, (PERTH); *Wilson 9982*, Wooroloo (AD).

SOUTH AUSTRALIA: *Kraehenbuehl 362a*, Viaduct Creek, Tonsley Park (AD); *T.J. Smith 1967a*, Hazelwood Park Reserve (AD); *Spooner 455*, Torrens Gorge (AD).

NEW SOUTH WALES: *McBarron 3882*, Walbundrie (SYD).

VICTORIA: *Beauglehole 55347*, 19 km SSW Hamilton (MEL).

C. sect. Anacampseroideae Haw., Ref. Pl. Succ. 9 (1921); Toelken, Contrib. Bolus Herb. 8: 181 (1977).

Type species: C. telephioides Haw.

Perennial scramblers or shrubs usually with dorsiventrally flattened leaves. *Inflorescence* a terminal thyrsoid with scale-like bracts and star-shaped flowers. *Calyx* shorter than corolla. *Carpels* with elongate ovaries gradually tapering into slender styles.

Species of this section are found naturally only in Africa and the Malgasy Republic most species occur in the Eastern Cape Province of South Africa.

*13. *C. sarmentosa* Harv. var. *sarmentosa*

Crassula sarmentosa Harv., Fl. Cap. 2: 348 (1862); Schonl., Trans. R. Soc. S. Afr. 17:199 (1929); Toelken, Contr. Bolus Herb. 8: 199 (1977).

Type: Natal, near Omblas, *Drege s.n.* (S, lecto.! (Toelken, 1977)).

Perennials with irregularly shaped tubers from which a number of procumbent stems up to 80 cm long are produced, little or rarely branched. *Leaves* sometimes with a petiole up to 3 mm long; lamina ovate to elliptic, 2-3.5 (-6) x 1.5-2 (-3.5) cm, acute or acuminate, rarely cuspidate, abruptly constricted towards the base, serrate, flat and little fleshy, green to yellowish-green often tinged red towards the margin. *Inflorescence* a terminal rounded or flat-topped thyrsoid borne above the leaves and with stalks of part-inflorescences as well as of individual flowers spreading at almost right angle to axis from which they develop; pedicels 1-3 mm long and not elongating when flowering; flowers 5-merous. *Calyx*: lobes linear-triangular, 1-3 mm long, sharply acute, fleshy, green. *Corolla* star-shaped, white often tinged red; lobes lanceolate, 4-8 mm long, acute to acuminate, spreading at about right angles to the axis. *Squamae* transversely oblong, 0.2-0.3 x 0.6-0.8 mm, truncate or scarcely emarginate, somewhat constricted towards the base, fleshy, pale yellow to white. *Ovaries* oblong-reniform in profile, gradually constricted into slender styles, with 12-16 ovules. *Follicles* slightly recurved, smooth, dehiscing by apical pore; seeds with rows of aculeate tubercles.

Naturalized on sandy soil in sclerophyll forest of *Eucalyptus maculata*, *E. paniculata* and *E. longifolia* near Nowra, New South Wales.

Known only from one vegetative specimen so that the additional information was tentatively supplied from natural populations in South Africa. There are only three species of *Crassula* which have a serrate to crenate leaf margin, and of those *C. crenata* and *C. sarmentosa* produce procumbent branches. The former is distinguished from the latter by a petiole on all leaves which have usually got a crenate margin.

Specimen examined

NEW SOUTH WALES: *Briggs 3074*, 1.5 km S Nowra (NSW).

D. sect. *Acutifolia* (Schonl.) Toelken, Contr. Bolus Herb. 8: 242 (1977).

Type species: C. acutifolia Lam.

Crassula (sect. *Campanulatae* Schonl., Trans. R. Soc. S. Afr. 17: 167 [1929]) group *Acutifolia* Schonl., Trans. R. Soc. S. Afr. 17: 167 (1929).

Perennial shrublets to shrubs with leaves often terete or almost so. *Inflorescence* a terminal thyrsoid with scale-like bracts and campanulate flowers. *Calyx* shorter than corolla. *Carpels* with elongate ovaries gradually tapering into short styles.

All species except *Crassula sarcocaulis* are restricted to Southern Africa and most species occur in the Cape Province.

*14. *C. tetragona* L., Sp. Pl. ed. 1, 283 (1753); Toelken, Contr. Bolus Herb. 8: 259 (1977).

Type: Caput Bonae Spei, sine leg. in LINN 400.6 (holo.!).

Subsp. *robusta* (Toelken) Toelken in J1 S. Afr. Bot. 41: 122 (1975).

Type: Cape, Pluto's Vale near Grahamstown, Toelken 4281 (BOL, holo.!).

C. robusta Toelken, J1 S. Afr. Bot. 38: 79 (1972).

C. tetragona sensu Thunb., Fl. Cap. ed. Schultes 283 (1823); sensu DC., Pl. Hist. Succ. 1, t. 19 (1799); Prodr. 3: 384 (1828); sensu Haw., Syn. Pl. Succ. 51 (1812); sensu Schonl., Trans. R. Soc. S. Afr. 17: 209 (1929), non L.

Perennial shrubs 30-50 (-100) cm high, usually moderately branched. *Leaves* linear-triangular, (1.5-) 2-3 (-4) x 0.3-0.5 (0.6) cm, usually acute, not or scarcely constricted towards the base, curved upwards, slightly dorsiventrally constricted at the base but terete or almost so towards the apex, green to bluish-green. *Inflorescence* a terminal rounded or flat-topped thyrsoid borne above the leaves; flowers 5-merous. *Calyx*: lobes triangular, c. 1 mm long, acute, fleshy, green. *Corolla* campanulate, white or cream; lobes lanceolate 1.5-2.5 mm long, acute, with dorsal ridge and recurved at the apex. *Squamae* transversely oblong, 0.2-0.4 x 0.5-0.6 mm, often slightly emarginate, scarcely constricted towards the base, slightly fleshy, yellow. *Ovaries* ovoid-conical, gradually constricted into short styles, with (8-) 10 ovules. *Follicles* erect, smooth, dehiscing by apical pore; seeds with ridges with aculeate tubercles.

Naturalized in disturbed areas near habitations or on dry slopes in the Mt Lofty Range.

At present the species is mainly known from a few localities where it has established itself in somewhat disturbed areas.

Specimens examined

SOUTH AUSTRALIA: *Ellis 71*, Happy Valley, Mt Lofty Range (AD).

Acknowledgements

The author gratefully acknowledges assistance received from Dr G. Wickens, Royal Botanic Gardens, Kew, with some problems concerning specimens from outside Australia. He is also indebted to Dr A.E. Orchard for information and material of a recent record of *C. moschata*. Thanks are also due to Dr J.P. Jessop for assistance and encouragement and Mr Ludwik Dutkiewicz for preparing the drawings.

The Directors/Curators of the following institutions are thanked for the loan of herbarium material: ADW, BRI, CANB, CBG, HO, K, LD, M, MEL, NSW, NT, PERTH, S, SYD, WELT.

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Index to Collections

Collectors' names are arranged alphabetically and followed by their numbers in numerical order, but when the collector did not use numbers they are according to dates. The herbarium numbers usually refer to individual sheets which are already provided with determinations so that their usefulness in the identification of specimens not seen by the author, is limited. Each collection is followed by an abbreviation of the taxa as follows:

<i>Crassula moschata</i>	MOS	<i>C. sieberana</i> ssp. <i>sieberana</i>	SIEB
<i>C. peduncularis</i>	PEDU	ssp. <i>tetramera</i>	TET
<i>C. helmsii</i>	HEL	<i>C. exserta</i>	EXS
<i>C. natans</i>	NAT	<i>C. colorata</i> var. <i>colorata</i>	COL
<i>C. glomerata</i>	GLO	var. <i>miriamiae</i>	MIR
<i>C. pedicellosa</i>	PED	var. <i>tuberculata</i>	TUB
<i>C. decumbens</i>	DEC	<i>C. alata</i>	ALA
<i>C. thunbergiana</i>	THU	<i>C. sarmentosa</i>	SAR
		<i>C. tetragona</i> ssp. <i>robusta</i>	ROB

Abraham s.n., ix.1910/TET; viii.1911/TET. Adams 1684/HEL; 2573/HEL; s.n., 1889/TET. H.W. Alcock s.n., viii.1896/COL. Alcock 8/COL; 26/TET; 180/DEC; 199/NAT; 239/PEDU; 260/NAT; 968/NAT; 1070/COL; 1115/TET; 1545 B/COL; 1545 A/TET; 1546/TET; 1646/DEC; 1664/TET; 2123/TET; 2309/TET; 2309a/TUB; 2334/DEC; 2391/TET; 2483/COL; 2438a/TET; 2876a/TET; 2971/DEC; 2972/NAT; 3711/TUB; 4131/TUB; 4655/TET; 4754/NAT; 5726/DEC; 5835/NAT; 5839/TET; 5851/DEC; 5856/TET; 5887/TET; 5889/DEC; 5902/TET. Allan in HO 30959, 14.viii.1979/MOS. Allen 294/TET. Amisberg s.n., 21.x.1966/DEC. Anderson 312/TET; s.n., xi.1969/TET; s.n., xi.1969/TUB. Andrews s.n., 14.vii.1901/NAT; s.n., ix.1901/DEC; s.n., vi.1902/DEC; s.n., vii.1902/NAT; s.n., viii-ix.1902/DEC; s.n., x.1903/TUB; s.n., x.1907/TUB. Aplin 827/COL; 2518/TUB; 6439/COL; 6442/DEC; 6493/COL; s.n., 19.x.1962/EXS. Archer in NSW 143651/SIEB; in NSW 143681/HEL. Ashby 306/DEC; 306a/TET. Aston 643/DEC; 1019/PED; 1069/PED; 1076/DEC; s.n., 21.x.1960/DEC; in MEL 91027, 21.x.1960/SIEB. Babbage in MEL 90519/DEC. Bacchus in MEL 90936/DEC. Bailey in NSW 143819, 3.x.1963/TUB. Bailey in NSW 143819a, 3.x.1963/TET; in BRI 244994, x.1901/TET. Barber s.n., iii.1953/HEL. Barker 1349/NAT; 2267/NAT; 2465/NAT; 2843/TET; 2893/TET; 2893a/TUB; 2967/TET; 3481/TET. Barnard in MEL 90736, 1882/TET. Barnsley et al. 87/COL. Bate in MEL 90703, 1881/SIEB. Batt in MEL 90752, 1889/TUB. Bêche in MEL 90716/SIEB; s.n., 30.xi.1881/HEL; s.n., i.1888/HEL; s.n., ii.1893/HEL; s.n. ii.1897/HEL; s.n., xii.1898/HEL. D. Black s.n., 8.x.1972/SIEB. J.M. Black s.n., 24.ix.1904/DEC; s.n. 8.x.1904/DEC; s.n., xii.1908/DEC; s.n., 2.x.1909/DEC; s.n., 9.x.1909/DEC; s.n., i.1912/HEL; s.n., 20.x.1913/DEC; s.n., 17.ix.1915/DEC; s.n., 17.x.1915/DEC; s.n. 11.ix.1916/DEC; s.n., 2.x.1916/DEC; s.n., 8.x.1916/DEC; s.n., 25.ix.1917/DEC; s.n., 29.xi.1917/DEC; s.n., 10.x.1919/DEC; s.n., 9.xi.1920/DEC; s.n., 1.xi.1925/DEC. R.A. Black s.n., 11.xi.1940/HEL. Blackburn s.n., xi.1953/EXS. Blake 2018/TET; 2529/SIEB; 19077/TET. Blakely s.n., x.1899/SIEB. Blakely & Shiress s.n., vii.1922/SIEB. Blaylock 230/TET; 251/COL; 658/DEC; 659/TET; 663/TET; 671/TET; 674/TET; 677/DEC; 684/TET; 715/TET; 760/TUB; 967/COL; 1014/DEC; 1019/PED; 1020/TET; 1344/TUB; 1571/TET; 1751/PED; 1980/PEDU; 2011/TET; 2022/TET; 2029/TUB. Boehm in MEL 90704/HEL. Bonney in MEL 90807/TUB. Bonton in MEL 90581, 1890/HEL; in MEL 90872, 1890/TET. Boorman s.n., iii.1917/TET; s.n., x.1901/GLO; s.n., x.1903/TET; s.n., iii.1906/HEL.

Bradley s.n., 26.ix.1966/DEC. *Briggs* 2178/DEC; 2179/PEDU; 2560/HEL; 2649/SIEB; 2899/SIEB; 3074/SAR; *s.n.*, 2.i.1953/SIEB; *s.n.*, 3.vi.1961/SIEB; *s.n.*, 5.ix.1965/DEC. *Brooker* 2694/NAT. *Brown* in MEL 90676/SIEB. *Brumby s.n.*, 1889/HEL. *Brummitt s.n.*, 9.xi.1892/TET; *s.n.*, 29.ix.1893/TUB; *s.n.*, x.1895/DEC. *Brummitt s.n.*, 1895/DEC. *Buflon* 28/DEC; *s.n.*, 1892/SIEB; *s.n.*, 1893/HEL. *Burbidge* 1792/SIEB; 6575/SIEB; 6585/SIEB; 6718/SIEB; 7586/HEL; 7775/SIEB; 8090/GLO; *Burbidge & Gray* 6144/HEL; 6161/SIEB; 6219/HEL; 6533/TET; 6563/HEL. *Burkitt s.n.*, 1877/TET. *Burns s.n.*, 16.xi.1951/HEL. *Calvert* in MEL 90835/SIEB. *Cambage* 1386/SIEB; 1726/ SIEB; 2401/SIEB; *s.n.*, viii.1905/TET; *s.n.*, vii.1906/SIEB; *s.n.*, ix.1908/TET; *s.n.*, 6.ii.1909/SIEB; *s.n.*, xi.1909/SIEB; *s.n.*, 29.vii.1911/SIEB; *s.n.*, 1.x.1916/TET; *s.n.*, ix.1917/SIEB. *Cameron s.n.*, 5.iii.1966/HEL. *Camfield s.n.*, 1897/DEC; *s.n.*, vii.1902/TET; *s.n.*, ix.1902/TET; *s.n.*, 18.ix.1902/DEC; *s.n.*, ii.1903/SIEB. *Campbell* in BRI 244990/HEL; in MEL 90779/HEL; in MEL 90897/TET; *s.n.*, xii.1905/DEC; *s.n.*, v.1882/HEL; *s.n.*, x.1899/TET; *s.n.*, x.1905/PED. *Canning* 135/TET; 426/SIEB; 1412/TET; 1648/TET; 2253/TET; 2541/SIEB; 2916/SIEB; 3157/SIEB; 3164/TET; 3325/SIEB; 3563/TET; 3726/TET; 3595/COL; 4388/TET; 4389/TET; 6597/COL; 4423/TET; *s.n.*, 11.x.1967/SIEB; *s.n.*, 25.x.1968/TET. *Carolin* 552/TET; 949/SIEB; 1003/SIEB; 4028/TET; 4028a/TUB; 5462/SIEB. *Carrick* 175/TUB; 1876/TET; 2070/DEC; 2071/DEC; 2312/TET; 2324/TET; 2324a/TUB; 2380/TET; 2921/TET; 3682/TUB; 3682a/TET; 3719/TUB; 3719a/TET; 3776/TUB; 3776a/TET; 3795/TUB; 3795a/TET; 3801/TET; 6093/DEC. *Carroll* 703/SIEB. *Carter s.n.*, 1883/SIEB. *Cashmore s.n.*, ix.1933/DEC; *s.n.*, ix.1933/TET. *Cayzer s.n.*, 3.xi.1917/NAT; *s.n.*, i.xi.1917/NAT. *Chadwick* 1450/COL. *Cheal s.n.*, 22.ix.1978/TET. *Cheel s.n.*, xi.1911/SIEB. *Chinnock* 48/HEL; 175/NAT; 349/COL; 349a/TUB; 1042/TUB; 1182/TET; 1288/TET; 1384/TET; 1525/TET; 1525A/TUB; 2535/TUB; 2731/TET; 2901/TET; 2960/TET; 3719/COL; 4101/TET; 4102/TUB; 4103/DEC; 4104/PED. *Chippendale* 6566/TET. *Chub s.n.*, xi.1898/HEL. *Clark* 219/EXS. *Cleland s.n.*, x.1908/NAT; *s.n.*, 24.x.1912/PEDU; *s.n.*, 29.ix.1913/DEC; *s.n.*, 17.viii.1921/TET; *s.n.*, 23.ix.1922/COL; *s.n.*, 31.viii.1924/TET; *s.n.*, 9.ix.1924/DEC; *s.n.*, 10.x.1925/TET; *s.n.*, 21.viii.1926/TET; in AD 97208162, 2.ix.1926/EXS; in AD 97208173, 2.ix.1926/TUB; *s.n.*, x.1926/DEC; *s.n.*, 21.i.1927/SIEB; *s.n.*, 26.viii.1927/DEC; *s.n.*, 28.viii.1927/DEC; in AD 97209158, 10.ix.1927/SIEB; in AD 97208215, 10.x.1927/TUB; in AD 97209322, 10.ix.1927/DEC; *s.n.*, 1.x.1927/DEC; *s.n.*, 17.i.1928/SIEB; *s.n.*, 20.viii.1928/COL; *s.n.*, 13.i.1929/HEL; *s.n.*, 24.x.1929/DEC; *s.n.*, 3.xi.1930/TET; *s.n.*, 30.xi.1930/TUB; *s.n.*, 17.i.1931/HEL; *s.n.*, 12.x.1932/DEC; *s.n.*, 12.xi.1932/PED; *s.n.*, 20.x.1933/DEC; *s.n.*, 5.x.1935/DEC; *s.n.*, 4.ii.1937/HEL; *s.n.*, ix.1937/DEC; *s.n.*, 13.x.1937/DEC; *s.n.*, ix.1938/DEC; *s.n.*, 20.viii.1939/TUB; *s.n.*, 1.ix.1942/NAT; *s.n.*, 24.ix.1942/TUB; *s.n.*, 1943/NAT; *s.n.*, 4.iii.1944/HEL; *s.n.*, 19.viii.1944/DEC; *s.n.*, 16.ix.1944/DEC; *s.n.*, 1.iii.1945/HEL; *s.n.*, 15.ii.1948/HEL; *s.n.*, 10.ii.1949/HEL; *s.n.*, 7.ix.1950/DEC; *s.n.*, 5.xi.1950/DEC; *s.n.*, 6.i.1951/HEL; *s.n.*, 8.i.1953/HEL; *s.n.*, 15.x.1953/TUB; *s.n.*, 21.viii.1954/TET; in AD 97209152, 3.ix.1955/TUB; in AD 97209152a, 3.ix.1955/TET; in AD 97209320, 3.ix.1955/DEC; *s.n.*, 23.ix.1956/TUB; *s.n.*, 19.ix.1957/TET; in AD 966090669, 23.vi.1960/TET; *s.n.*, 8.ix.1964/NAT; *s.n.*, 12.ix.1964/DEC; *s.n.*, 29.x.1966/DEC; *s.n.*, 7.ix.1968/TUB; *s.n.*, 14.ix.1968/TUB; *s.n.*, 21.ix.1968/TUB; *s.n.*, 21.ix.1968/TET; *s.n.*, 5.x.1968/TET; *s.n.*, 7.x.1968/NAT. *Consett-Davis s.n.*, 16.i.1941/TET; *s.n.*, ix.1942/SIEB. *Constable* 5199/HEL; 5204/DEC; *s.n.*, 12.ix.1953/SIEB; *s.n.*, 11.x.1954/SIEB; *s.n.*, 13.viii.1958/SIEB; *s.n.*, 22.x.1958/TET; *s.n.*, 6.v.1966/SIEB. *L.A. Constable & E.F. Constable s.n.*, 9.viii.1950/SIEB. *Copley* 450/TET; 607/COL; 607a/TET; 742/TET; 2070/TET; 2785/DEC; 3052/DEC; 3062/DEC; 3215/DEC; 3216/NAT; 3468/DEC; 3699/TET; 4284/DEC; 4284a/COL; 4986/NAT. *Cotter s.n.*, 1886/TET. *Coveny* 1268/TET; 5147/PEDU; 5719/TET; 5774/ SIEB; 8684/SIEB; 8797/HEL; *s.n.*, 18.vi.1966/TET. *Coveny et al.* 7522/SIEB. *Coveny & Armstrong* 5773/DEC. *Cranfield* 123/NAT; *s.n.*, 20.x.1977/COL; *s.n.*, 7.x.1978/TUB; *s.n.*, 20.x.1978/GLO; *s.n.*, 20.x.1978/COL. *Craven* 676/TET; 1617/SIEB; 2004/TET; 2158/SIEB. *Crawford s.n.*, x.1884/SIEB; *s.n.*, iv.1903/TET; *s.n.*, ii.1915/HEL. *Cross s.n.*, 17.ix.1938/TET. *Crisp* 534/TET; 535/TET; 1414/TET; 1414a/TUB; 1700/TUB; 1997/SIEB; 3901/SIEB; 4082/TUB; 4103/TET; 4291/TET; 4512a/SIEB. *Cronin s.n.*, 1889/COL. *Cullinmore* 66/DEC. *Cunningham* 768/TET. *Cunningham & Mithorpe* 1808/HEL; 3308/HEL. *Curdie* in MEL 90753/DEC; in MEL 90876/TET. *Curtis s.n.*, 23.xii.1944/HEL. *s.n.*, 3.iii.1952/HEL. *Czornij* 175/TUB; 175a/TET; 341/TUB; 341a/TET; 733/TET; 768/TET. *D'Alton* in MEL 90701/TET; in MEL 90781/DEC; in MEL 90838/PEDU; in NSW 143694/HEL. *Darbyshire* 1236/TET; *D'Arnay* 575/SIEB. *D'Arnay & Gray* 4577/SIEB. *Davis* in MEL 90881, 1889/DEC; in MEL 90845, 1890/DEC; in MEL 90886, 1890/PED. *M. Davis sub Ostenfeld* 1349/DEC; *Davis sub Ostenfeld* 1350/TUB; *Davis sub Ostenfeld* 1350a/COL; *Davis sub Ostenfeld* 1452/MIR. *Deane s.n.*, ix.1887/DEC; *s.n.*, viii.1887/DEC. *Dehardi* 621C/TUB. *Dempster s.n.*, 1870/TET. *Dietrich* 2782/DEC; *Dietrich* in BRI 244981/SIEB. *Dixon sub Tate s.n.*, x.1883/PED. *Dodson s.n.*, 24.ii.1973/HEL. *Donner* 957/SIEB; 2982/EXS; 3192/TET; 3253/TET; 3337/TET; 3372/TUB; 3372a/TET; 3505/TET; 3738/TET; 4159/HEL; 4999/TET. *Drummond* 114/TET; *Drummond* in MEL 90555/TUB; *Drummond* in MEL 90556/TUB; *Drummond* in MEL 90557/TUB; *Drummond* in MEL 90558/TUB; *Drummond* in MEL 90816/HEL. *Dumbleton s.n.*, 9.vii.1969/TUB. *Dunlop* 277/TET; 648/SIEB; 822/TET. *Durrington & Levine* 1175/TET. *Dwyer* 691/TET; *s.n.*, x.1915/DEC. *Eardley s.n.*, viii.1951/NAT; *Eaton* in MEL 90751, 1889/TET; in MEL 90860, 1889/TET. *Eckert* in MEL 52894, 1890/PEDU; in MEL 90858, 1890/TET; in MEL 90790, 1890/DEC; *s.n.*, 1891/HEL; *s.n.*, 1892/DEC; *s.n.*, 1892/TUB; *s.n.*, 1897/TET; *s.n.*, x.1906/PED. *Eichler* 12243/HEL; 12347/HEL; 12471/COL; 12472/COL; 12484/TET; 12495/TET; 12814/TUB; 12814a/TET; 13840B/NAT; 14006/TET; 14200/COL; 14201/DEC; 14258/DEC; 14879/HEL; 14896/HEL; 14949/TET; 14949a/COL; 15013/DEC; 15063/PED; 15068/DEC; 15078/DEC; 15100/PED; 15237/PED; 15322/TET; 15645/HEL; 15752/NAT; 15851/NAT; 15932/DEC; 16036/DEC; 16037/THU; 16646/HEL; 17041/TET; 17043/DEC; 17066/NAT; 17130/HEL; 17186/HEL; 17547/TET; 17731/HEL; 18330/

NAT; 19103/NAT; 19290/PED; 19353/TET; 19362/DEC; 19717/HEL; 19746/HEL; 19859/NAT; 20007F/PEDU; 20091/PED; 20307/EXS; 20707/TET; s.n., 2.iv.1956/HEL. Ellis 71/ROB. Evans 1560/SIEB. M. Evans 2615/SIEB. O.D. Evans s.n., 24.viii.1926/SIEB; s.n., ix.1949/HEL. Eveleigh 14, ix.1971/TUB. Everist 1635/TUB; 1636/TET; 7269/SIEB. Ewers s.n., 21.x.1956/TET. Fagg 587/SIEB; 865/HEL; s.n., 17.ix.1966/PED. Fatchen et al. s.n., 1.x.1976/TET; s.n., 1.x.1976/DEC. Filan s.n., 13.vii.1959/TET. Findlay s.n., 1883/SIEB. Fitzgerald 25/DEC; s.n., viii.1900/THU; in NSW 143676, x.1900/GLO; in NSW 143680, x.1900/NAT; in NSW 143677, x.1901/GLO; in NSW 143671/TUB. Fletcher s.n., ix.1887/TET; s.n., x.1889/TET; s.n., x.1890/TET; s.n., 20.viii.1892/DEC; s.n., 22.ix.1929/TUB; in NSW 143745/SIEB. Flynn s.n., i.1959/HEL. Ford s.n., 28.ix.1950/SIEB. Forrest in BRI 244998/SIEB. Forsyth s.n., x.1901/TET. Franklin s.n., 2.viii.1969/TET. Fraser & Vickery s.n., xii.1933/SIEB. French s.n., 1886/DEC; s.n., 1890/PED. Fullager in MEL 90808/TET. Galbraith s.n., 20.ix.1978/SIEB. Garden in NSW 143758, 9.x.1949/TET; in NSW 143823, 9.x.1949/TUB; s.n., 28.viii.1950/SIEB; s.n., 12.i.1956/HEL. Gardner 7680/NAT; 9374/TUB; s.n., vii.1942/DEC. Gates s.n., 1891/SIEB. Gauba s.n., 10.xii.1953/HEL; s.n., 7.x.1952/TET; s.n., 6.xi.1945/DEC; s.n., 23.i.1945/HEL. George 4593/TUB; 9515/NAT; 11352/COL. Gill s.n., x.1888/TET. Gray 3879/HEL; 4139/DEC; 5110/SIEB. C. Green in MEL 90743/TET. Green 622/DEC. Gregory s.n., ix.1964/DEC. Groener in MEL 90529/DEC. Grove in MEL 90608/HEL. Gunn 91/TET; 91a/SIEB; 91, 12.i.1838/TET; 91a, 12.i.1838/SIEB; 91, 5.xi.1842/SIEB; 393/HEL; 1117/DEC; 1967/PEDU; s.n., 2.xii.1848/DEC. Haegi 853/TET; 853a/TUB; 1172/EXS. Hain 62/SIEB. Haly in MEL 90671/TET. Hamilton s.n., vii.1899/TET; s.n., 1902/TUB; s.n., x.1909/SIEB. Hammond s.n., 1885/TET. Hannaford s.n., ii.1864/HEL; s.n., v.1871/TET; in NSW 143685/HEL; in NSW 143689/HEL; in NSW 143798/DEC; in NSW 143799/DEC; in MEL 90597/HEL. Hawke s.n., 4.xi.1882/DEC. Heal s.n., 1889/COL; s.n., 1889/DEC; s.n., 1895/TET. Heddle 53/COL; SCCP54/PED; MB85/PED. Helms s.n., 4.vi.1891/TET; s.n., viii.1891/TUB; s.n., viii.1891/TET; s.n., 12.x.1891/PED; in MEL 90567, xi.1891/PED; in NSW 143833, xi.1891/TUB; s.n., 23.ix.1897/DEC; s.n., 30.ix.1899/COL. Hemsley 6212/DEC; 6250/DEC. Henderson et al. 839/TET. Henry 1012/TET. Hentish s.n., 1895/DEC. Hester s.n., 1875/TET. Hickey s.n., xi.1884/SIEB; s.n., iii.1885/SIEB. Hicks s.n., 22.ix.1960/TET. Hilton 574/COL; s.n., 21.viii.1955/TET. Hirth s.n., 24.xii.1977/HEL. Hnatuk 770964/TUB; 771221/EXS. Holding s.n., 1887/TUB; in MEL 90717, 1889/TET; in MEL 90717a, 1889/TUB. Holtham s.n., xii.1914/TET; in MEL 90617/SIEB. Holtze s.n., 1891/TET. Hoogland 3050/SIEB; 10041/TET. Hope 21551/HEL. Hotchkiss 498/TET. Howe in MEL 90652/SIEB. Howitt s.n., 1882/SIEB. Hubbard 4243/SIEB. Hunt 546/HEL. 1054/TET; 1100/DEC; 1374/NAT; 1507/HEL; 1525/HEL; 1632/NAT; 1640/PED; 1867/HEL; 2093/NAT; 2256/NAT; 2329/NAT; 3207/DEC. Hussey 53/TET; s.n., 1893/DEC; s.n., 1894/TET; s.n., 1894/DEC; s.n., 1895/TET; in MEL 532736, 1895/PED. Ising 377/DEC; 1776a/TUB; 1545/COL; 1545a/TET; 2307/TUB; 2307a/TET; s.n., 30.viii.1918/DEC; in AD 966030835, 8.ix.1920/COL; in AD 966030835a, 9.ix.1920/TET; s.n., 14.x.1921/TET; in AD 966030724, 3.x.1922/DEC; in AD 966030849, 3.x.1922/TET; in AD 966031030, 4.x.1922/TET; s.n., 6.x.1922/TUB; s.n., 19.x.1924/DEC; s.n., x.1925/TUB; s.n., 13.viii.1925/TUB; s.n., 14.x.1925/DEC; s.n., 31.i.1926/HEL; s.n., 28.viii.1926/DEC; s.n., 1.ix.1926/TUB; s.n., 17.ix.1926/COL; s.n., 8.x.1927/TUB; s.n., 8.ix.1928/DEC; s.n., 8.ix.1928/TUB; in AD 966030932, 10.x.1928/TET; in AD 966031095, 21.x.1928/TET; in AD 966030942, 9.x.1929/TET; s.n., 8.xi.1929/TET; s.n., 14.x.1930/DEC; s.n., 10.iii.1934/HEL; in AD 97648585, 19.x.1934/TET; in AD 97648586, 19.x.1934/DEC; s.n., 23.x.1934/TET; s.n., 10.iii.1935/HEL; s.n., 25.viii.1935/TET; s.n., 29.viii.1935/EXS; s.n., 31.viii.1935/EXS; 31.viii.1935/PEDU; in AD 966030837, 1.ix.1935/PEDU; s.n., 2.ii.1938/HEL; s.n., 8.ix.1938/TUB; s.n., 12.x.1938/COL; s.n., 13.ix.1939/TET; s.n., 28.ix.1939/TET; s.n., 22.x.1939/DEC; s.n., 30.ii.1957/HEL; s.n., 20.ix.1962/DEC; s.n., 20.ix.1962/TUB; s.n., 20.ix.1962/TET; s.n., 21.ix.1968/DEC; s.n., 11.ix.1970/DEC; s.n., 25.viii.1970/TET; s.n., 27.viii.1970/DEC. Irvine s.n., viii.1889/TUB. Jackson 110/TET; 145/DEC; 284/HEL; 483/HEL; 590/NAT; 704/HEL; 1077/TET; 1196/NAT; 1368/EXS; 1768/TUB; 2366/TET; 2366a/TUB; 2587/TET; 2390/TET; 3152/TUB; 3421/TUB; 3421a/TET; 3483/TUB. Jacobs 604/TET; 1026/TUB; 2218/TET; 2895/TET. Jaegermann 440/TET. Jephcott in MEL 90727, 1883/DEC; in MEL 90749, 1883/TET; s.n., 1886/SIEB. Jessup & Gray/SIEB; 3492/TET; 3493/PEDU. Johnson 438/SIEB; s.n., 22.xi.1950/SIEB; s.n., 19.v.1951/SIEB; s.n., 13.vi.1965/SIEB. Johnson & Constable s.n., 17.viii.1950/SIEB; s.n., 26.i.1951/HEL. L. & T. Johnson 348/62/SIEB. Johnstone s.n., 1884/TET; in MEL 90832/DEC. James s.n., 1882/SIEB. Jones in MEL 90799/SIEB. Kate s.n., 1881/HEL. Keighery 420/COL; 421/PED; 457/COL; 462/EXS; 470/COL; 471/DEC; 472/TUB; 1016/DEC; 1175/ALA; 1231/TET; 1825/DEC. Kempen in AD 97744326, 7.x.1977/DEC; in AD 97744327, 7.x.1977/TET. Kennedy s.n., 1886/TET. Kenny s.n., 1911/SIEB; s.n., ix.1921/SIEB. Keys in BRI 244985/SIEB. Kirkpatrick s.n., xii.1970/SIEB. Kirkpatrick et al. s.n., 8-15.ii.1971/SIEB. Kleinschmidt s.n., 13.ix.1954/TET. Knoetzsch s.n., x.1884/SIEB. Koch 327/TUB; 863/DEC; 1935/DEC; s.n., ix.1902/TET; s.n., xii.1906/COL; in AD 97617601, viii.1898/COL; in AD 97617601a, viii.1898/TET. Kraehenbuehl 261/HEL; 352/TET; 362/ALA; 362a/DEC; 615/TET; 629/DEC; 637/TET; 660/TUB; 676/DEC; 1086/DEC; 1101/NAT; 1464/TET; 1464a/TUB; 1468/DEC; 1468a/TET; 1649/DEC; 1661/TET; 1680/PED; 1700/TET; 1700a/TUB; 1730/DEC; 1737/DEC; 1738/TET; 1756/PED; 1771/TET; 1771a/TUB; 1896/DEC; 1908/TET; 1939/PED; 2180/DEC; 2269/TET; 2270/DEC; 2285/PED; 3051/DEC; 3360/TET; 3512/TET; 3516/DEC; 3571/TET. Kuchel 325/TUB; 785/TUB; 1186/DEC; 2487/TUB. Latz 4101/TUB; 4101a/TET; 4123/TUB; 4145/TUB; 4190/TET; 4286/TET; 4310/TET; 4320/TET; 4365/TUB; 4497/TUB. Lauterer s.n., 1885/SIEB. Lawson s.n., 1887/TET. Leichardt in NSW 143718/HEL. Leigh S565/PEDU; S579/TET; s.n., 3.xii.1964/PEDU. Limson in BRI 244996/SIEB. Lindgren s.n., 5.x.1966/GLO. Litling in MEL 90761/SIEB. Lothian 730/TET; 732/DEC; 810/TUB; 810a/TET; 1531/TUB; 2113/TET; 2270/TUB; 2313/COL; 2483/

TET; 2543/TET; 2941/DEC; 2942/TET; 3132/TET; 4730/TET; 5051/TET. *Lothian & Francis* 390/TET. *Lucas s.n.*, 1878/PEDU; *s.n.*, iii.1924/TET. *Luchmann* in MEL 90852, 1890/TET; in MEL 90852a, 1890/COL. *McArthur s.n.*, ix.1978/GLO. *McBarron* 227/TET; 1214/TET; 1214a/TUB; 1297/SIEB; 1668/HEL; 1843/TET; 1977/TUB; 2002/DEC; 2110/DEC; 2127/DEC; 2876/HEL; 3464/TUB; 3464a/TET; 3479/PEDU; 3613/DEC; 3692/TUB; 3729/PEDU; 3882/ALA; 4420/HEL; 4966/DEC; 4968/TUB; 4968a/TET; 6213/HEL; 7897/HEL; *s.n.*, 26.xii.1947/TET; *s.n.*, 16.x.1965/TET; *s.n.*, 19.ix.1968/TET. *McCann s.n.*, 1881/SIEB. *McDonald & Stanley s.n.*, 14.iv.1977/SIEB. *McDonnell* 193/SIEB. *MacFarlane* 651/TET; 652/COL. *MacFarlane* 1189/DEC. *McIwer* in MEL 90800/SIEB. *Mackay s.n.*, 1890/TET. *McKee* 7025/HEL; 7575/DEC; 7605/PEDU; 11707/PEDU; 11710/DEC; *s.n.*, v.1928/SIEB. *McKinnon* in MEL 90668/SIEB. *McLean* in MEL 536024/HEL. *Macpherson s.n.*, 1898/TET. *Maidens s.n.*, xii.1896/HEL; *s.n.*, viii.1898/SIEB; *s.n.*, x.1898/SIEB; *s.n.*, xii.1899/SIEB; *s.n.*, x.1909/COL; *s.n.*, xi.1909/COL; in NSW 143669, xi.1909/COL; in NSW 143669a, xi.1909/TET. *Maiden & Forsyth s.n.*, i.1899/SIEB. *Mair s.n.*, 17.x.1951/DEC. *Martensz* 4038/SIEB. *Martin s.n.*, 1887/DEC. *Martinsen* 69/TET. *Mathews* in MEL 90795, 1889/TUB; in MEL 90795a, 1889/TET; *s.n.*, 1893/DEC. *Mattingley s.n.*, 28.xi.1937/SIEB. *Meebold* 2303/SIEB. 10199/NAT; 10868/NAT; 21698/DEC; 21699/TET. *Melville* 864/DEC; 1346/DEC; 1519/TET; 3145/HEL; *s.n.*, 30.viii.1952/SIEB. *Melville & Bond* 352/TUB; 352a/COL. *Melville et al.* 1017/TET. *Melville et al.* 1519/TET. *Melville et al.* 1110/TUB. *Melville & Mair* 722/SIEB. *Merrall s.n.*, 1888/COL; in MEL 90791, 1890/TUB; in MEL 90791a, 1890/TET; in MEL 90861, 1890/COL; in MEL 90730/TUB. *Milthorpe & Cunningham* 1343/TUB; 2655/TUB. *Minchin* in MEL 90511, 1887/TET; in MEL 90734, 1887/TET; in MEL 90735, 1887/TUB; in MEL 90770, 1887/TUB; in MEL 90796, x.1887/TET; in MEL 90827, 1887/TET; in MEL 90865, 1887/DEC; in MEL 90865, 1887/DEC. *Moker s.n.*, x.1923/TET. *Moore* 4025B/TET; 4527A/TET; *s.n.*, 15.ix.1945/DEC; *s.n.*, 18.ix.1945/DEC; *s.n.*, 20.viii.1963/DEC. *Morris* in NSW 143776, 2.ix.1920/TET; *s.n.*, in NSW 143816, 2.ix.1920/TUB; *s.n.*, in NSW 143771, 14.viii.1921/TET; *s.n.*, in NSW 143667, 14.viii.1921/TUB. *D.I. Morris* 7967, 9.i.1979/HEL. *Morrison s.n.*, xii.1871/HEL; *s.n.*, 23.xi.1889/SIEB; *s.n.*, 19.ix.1890/DEC; *s.n.*, 28.ii.1891/HEL; *s.n.*, 24.x.1891/PEDU; *s.n.*, 7.xii.1892/HEL; *s.n.*, 11.xi.1893/PEDU; *s.n.*, 9.xii.1893/HEL; *s.n.*, 28.ix.1885/TET; *s.n.*, 18.viii.1898/NAT; *s.n.*, 15.ix.1899/COL; *s.n.*, 3.vii.1900/NAT; *s.n.*, 31.viii.1900/NAT; *s.n.*, 23.ix.1900/COL; *s.n.*, 10.x.1900/COL; *s.n.*, 26.vii.1902/NAT; *s.n.*, 15.xi.1904/DEC. *A. Morton s.n.*, 26.iv.1979/SIEB. *L. Morton s.n.*, 1887/TET. *Mueller s.n.*, iii.1847/HEL; *s.n.*, 28.iv.1848/HEL; *s.n.*, viii.1848/DEC; *s.n.*, 14.ix.1848/DEC; *s.n.*, 23.ix.1848/TET; *s.n.*, xii.1848/TET; *s.n.*, ix.1851/HEL; *s.n.*, x.1851/PEDU; *s.n.*, xi.1851/PEDU; *s.n.*, xii.1851/TET; *s.n.*, ix.1852/DEC; *s.n.*, x.1852/SIEB; in MEL 90515, xi.1852/DEC; in MEL 90581, xi.1852/PEDU; *s.n.*, i.1853/HEL; *s.n.*, iii.1854/HEL; *s.n.*, i.1955/HEL; *s.n.*, vii.1855/SIEB; *s.n.*, xii.1856/TET; *s.n.*, xii.1862/SIEB; *s.n.*, ix.1867/PEDU; in MEL 90516, x.1867/PED; in MEL 90553, x.1867/EXS; in MEL 90578, x.1867/PEDU; in MEL 90900, 1867/PEDU; *s.n.*, 7.ii.1869/HEL; *s.n.*, in MEL 90508, x.1875/PEDU; in MEL 90539, x.1875/DEC; in MEL 90764, 1875/SIEB; in MEL 90764, 1875/DEC; *s.n.*, in MEL 90764a 1875/SIEB; *s.n.*, x.1877/COL; *s.n.*, x.1887/TET; *s.n.*, xi.1887/TET; *s.n.*, xi.1892/NAT; in MEL 90495/PEDU; in MEL 90504/HEL; in MEL 90527/DEC; in MEL 90534/DEC; in MEL 90534a/TET; in MEL 90536/DEC; in MEL 90549/TET; in MEL 90574/PEDU; in MEL 90594/DEC; in MEL 90595/HEL; in MEL 90598/HEL; in MEL 90633/HEL; in MEL 90634/HEL; in MEL 90637/COL; in MEL 90662/SIEB; in MEL 90672/TET; in MEL 90681/SIEB; in MEL 90694/TET; in MEL 90698/SIEB; in MEL 90599/HEL; 90938/SIEB; in MEL 90939/SIEB; in MEL 90941/HEL; in MEL 90942/EXS; in MEL 90943/TET; in NSW 143698/HEL; in NSW 143763/PEDU. *M. Mueller* 1272/HEL. *Muir* 154/TUB; 162/TET; 1464/PED; 1547/DEC; 2972/SIEB; 3496/TET; 4536/TET; 4537/SIEB; 5462/TET; 5463/DEC; 5852/PED; in MEL 90837/TET. *Mullett s.n.*, xii.1966/SIEB. *Murray* 165/COL; 165a/TUB. *Murray-Smith s.n.*, 17.ix.1970/SIEB. *Musson s.n.*, 1891/TET. *Neate s.n.*, in MEL 90699/TET. *Nelson* 503/TUB; 504/TET; *s.n.*, 24.x.1972/COL. *Oakden s.n.*, xii.1886/SIEB. *Officer s.n.*, xi.1903/TET; in NSW 143767, xii.1913/TET; in NSW 143820, xii.1913/TUB; *s.n.*, in NSW 143821, xii.1913/TUB; in NSW 143822, xii.1913/TUB; in NSW 143784, x.1917/DEC; in NSW 143771, x.1917/TET. *Oldfield* in MEL 90550/EXS; in MEL 90552/EXS. *Oliver s.n.*, 1881/TET. *Olsen* 1989/SIEB. *Orchard* 1166/NAT; 1215/COL; 1216/PED; 1335/EXS; 4821/HEL. *O'Reilly s.n.*, vii.1906/TET. *Osborn s.n.*, 8.i.1924/TET. *O'Shannesy* 68/SIEB; 3001/TET; in MEL 90892/SIEB. *Ostenfeld* 358/DEC; 359/DEC; 360/COL; 361/NAT; 1104/PED; 1350/TUB. *Oxenford s.n.*, 18.viii.1940/SIEB. *Paltridge* 16/TET; *s.n.*, 7.ix.1930/COL; *s.n.*, 26.viii.1931/TET. *Patton s.n.*, 18.i.1921/HEL; *s.n.*, 20.i.1936/SIEB. *Pedley & Johnson* 59/TET. *Perry* 559/COL; 716/DEC; in MEL 530698, 25.ix.1960/COL; in MEL 530699, 25.ix.1960/DEC; *s.n.*, 10.x.1962/TET. *Phillips* 221/TET; 1055A/NAT; 1149/TET; *s.n.*, 24.xi.1961/SIEB; in CBG 039836, 18.ix.1965/TUB; in CBG 039836a, 18.ix.1965/TET; *s.n.*, 22.xi.1965/TET; *s.n.*, 19.ix.1966/SIEB; *s.n.*, 22.vi.1967/SIEB; *s.n.*, 24.ix.1968/TUB. *Pickard* 197/TET; 1887/SIEB; 2653/SIEB; 2746/SIEB; 2783/SIEB; 3133/TET; 3319/SIEB; *s.n.*, 11.ix.1970/SIEB. *Pickard & Blaxell* 273/SIEB. *Porter s.n.*, vi.1885/SIEB. *Preiss* 1929/COL; 1931/COL; 1932/COL; 241/DEC. *Pullen* 1909/TET; 4283/TET. *Purdie* 125/DEC; 559D/TET. *Pyre s.n.*, 1889/TUB. *Raynor s.n.*, 20.iv.1870/HEL. *Reader s.n.*, xii.1879/TET; *s.n.*, 1880/SIEB; *s.n.*, 23.v.1883/TET; *s.n.*, 1888/HEL; *s.n.*, 6.ii.1892/EXS; *s.n.*, 25.ix.1892/TET; *s.n.*, 2.x.1892/PEDU; *s.n.*, 1892/HEL; in MEL 90566, 5.xi.1893/PED; in MEL 90890, 5.xi.1893/EXS; *s.n.*, 29.x.1893/DEC; *s.n.*, 1893/DEC; *s.n.*, 14.x.1894/PEDU; *s.n.*, 16.x.1895/PED; *s.n.*, 21.x.1894/EXS; *s.n.*, 13.xi.1897/EXS; *s.n.*, 28.xi.1897/HEL; *s.n.*, 12.xii.1897/HEL; *s.n.*, 9.x.1898/TET; *s.n.*, 14.x.1898/EXS; *s.n.*, 16.x.1898/TET; *s.n.*, 16.x.1898/SIEB; *s.n.*, 20.xi.1898/DEC; *s.n.*, 21.x.1900/PEDU; *s.n.*, 31.x.1903/DEC; in MEL 88454/EXS; *s.n.*, in MEL 90585/HEL; *s.n.*, in MEL 536020/PEDU. *Richards s.n.*, 1877/TET; *s.n.*, 1885/COL. *Richley* 1431A/TET; F8/TUB. *Robbins* sub *Beaulehole* 7293/HEL; 7294/

COL; 7296/TET; 7297/TUB; 7298/DEC; 17076/HEL; 17755/DEC; 17756/TET; 18364/DEC; 19593/TET; 42244/DEC; 42246/TET; 42247/TUB. Rodd 830/HEL; 889/TET; 1392/SIEB; s.n., 21.vi.1970/SIEB. Rodd & Coveny 951/PEDU. Rodway 2800/DEC; 2801/DEC; 2802/DEC; 2807/SIEB; 2813/SIEB; 2814/SIEB; 2815/SIEB; 2816/SIEB; 11152/DEC; 13746/SIEB; 13999/SIEB; 14542/DEC; 15628/DEC; s.n., xii.1891/HEL; s.n., i.1896/HEL; s.n., ii.1898/DEC; s.n., i.x.1929/TET; s.n., x.1929/SIEB; s.n., 13.iv.1931/SIEB; s.n., 20.i.1933/DEC; s.n., 10.x.1933/DEC; s.n., 28.viii.1938/SIEB; s.n., viii.1938/SIEB. Rogers s.n., ix.1907/TET; s.n., ix.1908/DEC. Rohrlach 600/TET. Royce 1248/TUB; 1251/DEC; 1272/EXS; 2115/TUB; 2227/COL; 2228/DEC; 2283/PED; 2851/GLO; 3177/GLO; 3927/THU; 4510/PED; 4554/COL; 4641/COL; 4658/THU; 4666/GLO; 4904/GLO; 5156/COL; 5195/COL; 5457/NAT; 7900/DEC; 7904/EXS; 7915/COL; 8175/COL; 8176/DEC; 8200/EXS; 8233/NAT; 9671/TUB; s.n., 24.x.1944/THU; s.n., ix.1945/TUB; s.n., 24.ix.1946/DEC. Rupp s.n., iv.1914/HEL. St. John s.n., 29.xi.1901/HEL; s.n., in MEL 90610, 12.xi.1908/HEL. Sainty s.n., i.1967/HEL; s.n., i.1965/HEL. Salasoo 42/COL; 42a/TET; 99/DEC; 274/DEC; 408/TUB; 433/NAT; 2456/SIEB; s.n., 9.i.1967/SIEB. Sammy 70/COL. Savell s.n., 1884/TUB. Schodde 394/TET; 857/TET; 888/DEC; 890/COL; 926/DEC; 3161/SIEB; 5160/SIEB. Scrymgeour 60/COL. Seabrook 602/NAT. Sewell s.n., 1883/NAT; s.n., xii.1884/DEC. Sharpe 341/SIEB; 2406/SIEB. Sharpe & Hockings 653/TET. Sharpe & Soul 1214/SIEB. Sharrad 310/TET; 735/DEC; 736/TET; 736a/TUB; 842a/TET. Shaw 348/TET. Shillabeer s.n., 31.ix.1960/TET. Sieber 173/SIEB. Sikkes 61/TET; 634/TET; 1103/TET. Simmonds in BRI 111618/SIEB. Sims sub Cleland s.n., 17.viii.1968/NAT. Slade 1899/TET. Slater s.n., 1870/TET. Smith s.n., 3.i.1953/PEDU. T.J. Smith 194/TET; 217/TUB; 224/TET; 225/DEC; 241/DEC; 246/DEC; 248/TET; 249/DEC; 334/DEC; 544/TET; 546/DEC; 585/TET; 620/TET; 658/TET; 1226/DEC; 1405/DEC; 1406/TET; 1418/TET; 1466/TET; 1498/NAT; 1530/TET; 1531/DEC; 1737/COL; 1959/NAT; 1962/NAT; 1817/TET; 1889/TUB; 1970/DEC; 1983/COL; 1988/TUB; 2039/PED; 2054/TUB; 2273/TUB; s.n., 31.viii.1970/COL; s.n., 31.viii.1970/DEC; s.n., 25.ix.1970/ALA. Specht 2117/SIEB; 2269/COL; 2338/TUB; 2518/COL; 2622/COL; s.n., ix.1952/DEC; s.n., x.1952/TET. Solling 555/TET. Spang s.n., 1882/TET. Speme s.n., 1889/DEC. Spicer in MEL 90531/DEC. Spooner 266/PED; 300/DEC; 452/NAT; 453/DEC; 454/TET; 455/ALA; 559/TET; 1401/NAT; 1167/PED; 1168/PED; 1234/COL; 1754/HEL; 2339/TET; 2530/DEC; 2531/NAT; 2541a/TET; 2542/DEC; 2543/PED; 3063/COL; 3501/NAT; 3572/PED; 3851/HEL; 4124/NAT; 4237/TET; 4917/DEC; 5301/DEC. Stamard s.n., ix.1916/TUB. Stanley & Reynolds 7849/TET. Stewart s.n., 13.i.1951/SIEB. Storr s.n., ix.1959/COL; s.n., 6.ix.1969/COL. Story in MEL 90673/TET; in MEL 90686/SIEB; in MEL 90688/TET. Stove 221/TUB; 221a/TET; 293/TET; 293a/TUB; 336/TET; 337/TUB; 339/TET; 439/TUB; 439a/TET; 464/TET; 620/TET; 646/TUB; 657/TET; 657a/TUB. Stoward s.n., x.1912/COL. Strahams s.n., 9.x.1910/TUB. Streiman 2843/SIEB; 2876/SIEB; 3255/SIEB; 3320/SIEB. Stuart in MEL 90683/SIEB; in MEL 90934/PEDU. Stuwe 517/TET. Sullivan 32/DEC; s.n., x.1872/TET; s.n., 10.xi.1873/EXS; s.n., ix.1879/DEC; in MEL 90507, xi.1883/HEL; in MEL 90895, xi.1883/HEL; s.n., 1893/HEL; s.n., in MEL 90644/TET; s.n., in MEL 90644a/TUB. Suvell s.n., 1889/TET. Swinbourne 33/COL; 165/COL. Swindley s.n., 1.xii.1959/HEL; s.n., 9.xii.1959/HEL. Symon 90/DEC; 217/TET; 544/TUB; 597/TET; 718/DEC; 719/TET; 720/ALA; 1346/TET; 1492/TET; 2061/HEL; 2555/TET; 2863/DEC; 2866/TET; 4097/COL; 6168B/COL; 6169/EXS; 6303/TET; 6481/TET; 6481a/TUB; 6482/EXS; 7254/TUB; 7254A/TET; 7318/TET; 7551/COL; 7555/TET; 8089/TUB; 8089E/TET; 8097/DEC; 8648/TET; 8972B/TET; 8976A/DEC; 9560C/TET; 9555B/TET; 10766/TUB; 10860/DEC; s.n., in ADW 21090, 27.ix.1959/TET; s.n., in ADW 21090a, 27.ix.1959/COL. Tadtell s.n., ix.1921/SIEB; s.n., x.1917/SIEB. Tate s.n., 23.v.1880/HEL; s.n., 27.x.1881/DEC; s.n., 28.x.1882/DEC; s.n., xi.1882/PEDU; s.n., 4.xi.1882/PEDU; s.n., 21.xi.1882/HEL; s.n., i.1882/HEL; s.n., 16.xi.1883/HEL; s.n., xi.1883/PED; s.n., 1883/HEL; s.n., 30.ix.1887/DEC; s.n., 1894/TUB; s.n., ix.1896/TET; s.n., xii.1896/HEL; s.n., ix.1897/DEC. Taylor s.n., 4.i.1965/NAT. Telfer 71/TET. Telford 1531/SIEB; 1603/SIEB; 3095/SIEB; 4193/SIEB. Tenison-Woods in MEL 90793/SIEB; in BRI 244997/SIEB. Tepper 169/PED; 191/COL; 192/TET; 999/DEC; 1055/DEC; 1082/DEC; 1093/PED; 1395/HEL; in MEL 90728, 1879/COL; in MEL 90729, 1879/TET; in MEL 90859, 1879/TET; in MEL 907220, i.1880/TUB; in MEL 90759, i.1880/TUB; s.n., 1880/DEC; s.n., 1881/DEC; s.n., 12.xi.1886/TET; in MEL 90579/PEDU; in MEL 90805/TET; in MEL 90814/TET; in MEL 90878/TET. Thom s.n., 1891/SIEB. Thompson 255/SIEB; 824/HEL; 2035/TET; 2856/HEL; s.n., 20.iii.1962/HEL; s.n., 24.i.1968/HEL; in NSW 87106, 2.ix.1968/TUB; in NSW 81107, 2.ix.1968/TET. Thornton s.n., 1889/TUB. Tietkens s.n., 1874/PEDU. Tildem 601/SIEB. Toelken 6000/COL; 6001/TET; 6004/TUB; 6037/TUB; 6048/TUB; 6050/TUB; 6059/TUB; 6059A/TET; 6079/TET; 6158/TUB; 6163/TET; 6178/TUB; 6235/TUB; 6421/EXS; 6424/TUB; 6439/THU; 6443/DEC; 6445/DEC; 6454/COL; 6454A/TUB; 6463/COL; 6464/EXS; 6472/DEC; 6479/EXS; 6494/DEC; 6489/EXS; 6491/COL; 6491A/TUB; 6492/EXS; 6493/TET; 6495/NAT; 6497/PED; 6516/EXS; 6531/TET; 6532/COL; 6532A/TUB; 6543/COL; 6543A/TUB; 6546/SIEB. Trudgen 2209/PED; 2210/TUB; 2211/DEC. Turner s.n., 29.ix.1960/TUB; s.n., in MEL 90970/TUB. Turvey s.n., 6.ix.1965/THU; s.n., 21.vii.1968/TUB; s.n., 14.viii.1968/TET. Urquhart s.n., 1889/TET. Vasek s.n., 20.ix.1968/TET. Vickery s.n., 14.x.1949/HEL. Wace 21/COL; 22/TET; s.n., 7.xi.1970/DEC. Wakefield 3450/TET; 3451/PEDU; 3452/DEC; 4269/HEL; 4668/DEC. Walker s.n., i.1962/HEL; s.n., 20.vii.1967/TET. Walter s.n., x.1887/TET; s.n., x.1892/HEL; s.n., x.1899/TET; s.n., x.1899/TET; in MEL 90771/PED; in MEL 90773/DEC; in MEL 90774/TET; in MEL 90775/TET; in MEL 90804/DEC. Watts 1170/DEC; 1170a/TET. Weber 51/TUB; 1108/TET; 1140/TET; 1310/TET; 1310a/TUB; 1331/TUB; 1331a/TET; 1419/TUB; 1517/TET; 1517a/TUB; 1641/DEC; 1714/TET; 1764/NAT; 1893/PEDU; 2204/TET; 2204a/TUB; 2323C/TUB; 2465/TET; 2466/TUB; 2540/COL; 2540a/TUB; 2697CTUB; 3066/TET; 3249A/COL; 3249B/TET; 3254B/PEDU; 3474/PEDU; 3562/TET; 3562a/COL; 3792/TET; 3793/DEC; 4201/TET;

4270/TET; 5313/TET; 5327/TET; 5327a/TUB; 5620/TET. *Wehl* s.n., 1874/DEC; in MEL 90748, 1882/TET; in MEL 90875, 1882/TET; s.n., 1889/TUB. *Went* 35/COL. *Weston* 10475/COL; 10532/COL; 10546/COL; 10547/COL; 10576/COL. *White* s.n., 30.x.1953/SIEB. *Whan* in MEL 90648/TET; in NSW 143801/DEC; in NSW 143802/DEC. *Wheatley* s.n./ALA. *Wheeler* 37/DEC; 119/DEC; 164/TET; 195/SIEB; 221/DEC; 658a/TET; 687/COL; 697/COL; 775a/EXS; 775b/COL; 775c/TET; 1017/PED; 1058a/TET; 1058b/COL; 1146/TET; 1206/DEC; 1207/TET; 1425/TET. *Whibley* 229/TET; 229a/TUB; 422/NAT; 606/COL; 606a/TET; 861/DEC; 997/TET; 1105/TET; 1105a/TUB; 1307/PED; 1319/DEC; 1470/DEC; 1594/TET; 2300/COL; 2300a/TUB; 2581/TET; 2888/TET; 2894/DEC; 2933/DEC; 2938/TET; 3567/TET; 4055/COL; 4056/TET; 4154/DEC; 4372/TET; 4385/TET; 6322/TET; 6400/TET; 6410/TET; 6451/TUB; 6451a/TET; 6544/TET; 6602/TUB; 6603/TET; 6674/TET; 6783/TET. *Whinray* 22/HEL; 53/DEC; 54/DEC; 54b/TET; 54c/TET; 54f/TET; 55a/DEC; 55b/DEC; 184/PED; 278/TET; 285/HEL; 290/TET; 291/SIEB; 313/TET; 341/TET; 346/DEC; 371/TET; 478/TET; 509/PEDU; 513/TET; 519/DEC; 554/DEC; 559/TET; 659/TET; 582/PEDU; 665/DEC; 761/TET; 786/SIEB; 810/DEC; 866/HEL; 877/PEDU; 888/DEC; 926/DEC; 1078/DEC; 1100/TET; 1111/PED; 1140/TET; 1151/TET; 1251/PEDU; 1278/HEL; 1337/TET; 1349/TET; 1356/DEC; 1490/DEC; 1509/TET; 1653/SIEB; 1759/SIEB; s.n., iv.1966/SIEB; s.n., 26.xi.1966/HEL; s.n., 1966/SIEB. *White* 6082/SIEB; 8609/SIEB; 9350/TET; s.n., vi.1913/SIEB; s.n., vii.1916/SIEB; s.n., viii.1916/TET; s.n., iv.1918/SIEB; s.n., vii.1919/TET; in BRI 244983, x.1919/SIEB; in AD 966040502, x.1919/SIEB; s.n., x.1921/SIEB. *Whittaker & Niering* s.n., 15.xii.1975/TET. *Wilhelmi* in MEL 90600/HEL; in MEL 90811/TET. *Willcocks* 4/TUB. *Williamson* 482/DEC; in MEL 90512, 1893/PED; in MEL 90572, 1893/PED; in MEL 90586, 1893/HEL; in MEL 90657, 1893/TET; in MEL 90786, 1893/DEC; in NSW 143832, x.1900/DEC; in NSW 143662, x.1900/TET; s.n., ix.1901/PEDU; s.n., x.1901/PEDU; s.n., xii.1901/HEL; s.n., xi.1902/TET; s.n., xi.1903/HEL; s.n., x.1905/PED; s.n., xi.1905/PED; s.n., ii.1908/PEDU; s.n., ix.1910/PED; s.n., x.1911/DEC. *Williams* 119/TET; 4121/TET; 5608/TET; 5609/DEC; 5731/DEC; 5732/TET; 5736/DEC; s.n., v.1916/SIEB; in NSW 143737/SIEB. *Willis* s.n., 16.xi.1929/HEL; s.n., 30.i.1938/SIEB; in MEL 90967, 2.ix.1948/COL; in MEL 91052, 2.ix.1948/TET; in MEL 90546, 8.ii.1950/TUB; in MEL 90485, 8.ii.1950/DEC; s.n., 8.xi.1950/NAT; s.n., 18.xi.1950/TET; s.n., 6.ix.1963/NAT; s.n., 17.xi.1963/PEDU; s.n., 11.ix.1965/TET; s.n., 8.x.1976/DEC. *Wilson* 505/DEC; 579/DEC; s.n., 1880/TET; s.n., 1881/DEC; in MEL 90763, 1884/HEL; in MEL 90780, 1884/PEDU; in MEL 532284, 1884/PED; in MEL 90708, 1890/DEC; in MEL 528993, 1890/PEDU. *P.G. Wilson* 33/COL; 120/TUB; 120a/TET; 645/PEDU; 648/PED; 1090/HEL; 1268/TET; 1347/SIEB; 1959/PEDU; 2020/TET; 2038/TET; 2120/DEC; 2145/DEC; 2874/NAT; 3958/DEC; 4248/DEC; 5439/NAT; 6201/DEC; 6202/NAT; 6204/NAT; 6250/GLO; 6302/TET; 6765/NAT; 6771/TUB; 8136/TET; 8178m/DEC; 8178i/EXS; 8749/TUB; 8156/NAT; 9982/ALA; 9998a/PED; 10044/TET; 11637/EXS; 11660/NAT; 11682/DEC; 11683/ALA; 11684/NAT; 11685/DEC; 11686/THU; 11688/DEC; 11687/ALA; s.n., 6.x.1970/EXS. *Worsley* s.n., 1889/TET. *Woolls* s.n., 1875/HEL; in MEL 90532/DEC; in MEL 90670/SIEB; s.n., in MEL 90690/SIEB. *Wooster* s.n., 1882/DEC. *Wrightley* 73/148/TET; s.n., 7.iii.1968/SIEB.

THE *DROSERA PELTATA* - *D. AURICULATA* COMPLEX

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Abstract

The correct authority of *Drosera peltata* is shown to be Thunberg and a specimen on *Herb. Thunberg* 7720 (UPS) is chosen as the new lectotype of this species. *D. peltata* and *D. auriculata* are variable taxa which consistently intergrade in parts of their wide range. As a consequence, *D. auriculata* is reduced to a subspecies of *D. peltata*. A description of *D. peltata*, a key to the two subspecies and descriptions of each are presented.

Introduction

While preparing accounts of the genus *Drosera* for the 'Handbook Flora of Papua New Guinea' and 'The Alpine Flora of New Guinea', I noted an apparent difference between my initial concept of *Drosera peltata* and van Steenis' (1953) circumscription of this species. Upon further investigation, it was soon evident that this species had been variously interpreted by different authors. Furthermore, some of the New Guinea material appeared to be intermediate between *D. peltata* and *D. auriculata*. Therefore, I decided that it was necessary to study material of these two taxa over their full range, so that the New Guinea situation might be resolved.

During a brief visit to the Royal Botanic Gardens, Kew, in 1978, the type material of the various taxa were studied, but only with reference to New Guinea. It is only recently that I have become aware of some of the broader taxonomic and typification problems within the genus. However, while it is worthwhile to discuss the typification of the names, I feel that it is inappropriate for me to lectotypify many of the synonyms without re-examining the relevant material as some characters are subject to misinterpretation in photographs. Furthermore, the genus is in need of revision and such decisions would be better left until then.

Herbarium abbreviations are those given in Holmgren & Keuken (1974).

The Author of *Drosera peltata*

It has become clear to me that *D. peltata* has been attributed to the wrong author. This error has arisen through a lack of awareness of the correct publication dates and ignorance by most workers of the publication in which the protologue is located.

Drosera peltata was described by Thunberg (1797). This publication has been ignored by all subsequent workers, with the exception of Labillardière (1805: page number incorrectly cited) who nevertheless accredited the protologue to Willdenow. The title page of Thunberg's work has the publication date as '29 Novemb. 1797'. Juel (1918) confirmed the year. Stafleu (1967) has indicated that eleven days should be added to allow for differences in the calendars used by various countries at that time. This suggests that the publication date should be considered to be 10 December, 1797. However, Moberg (pers. comm.) of UPS, where Thunberg's herbarium is held, believes that "There is no doubt that the Dissert. 2: 295 appeared earlier than the day of defence (29 Nov. 1797)—rather some weeks earlier".

J.E. Smith has, until recently, almost universally been cited as the author of this species. It appears that de Candolle (1824) was the first author to make this assumption. Subsequently, the protologue has been cited as published in many different journals.

Early authors, such as Sprengel (1824) and Wight & Arnott (1834) cited it as being published by Smith in Rees' 'The Cyclopaedia' in 1819, while Planchon (1848), Bentham (1864), Diels (1906) and van Steenis (1933, 1953) stated that it was published by Smith in Willdenow's 'Species Plantarum' in 1798. Labillardière (1805), although referring to Thunberg's work, was apparently unaware that volume 1, part 2, of Willdenow's 'Species Plantarum' was published in July 1798, rather than 1797 as stated on the title page (refer Stafleu, 1967).

In 1965, Eichler modified the citation to "Sm. *ex* Willd.". This modification has been accepted by most workers, including Beadle *et al* (1972), Willis (1973) and Conn (1980). It is clear from Willendow's (1798) publication that *D. peltata* was a manuscript name of Smith's ("Smith in Litt.") and since Willdenow initialed the relevant diagnosis with "W" for Willdenow, it is certain that he provided the description. Although, Eichler (1965) clearly established that Smith was not the author of this species, he did not discuss the effect of such a change on the lectotypification, nor was he aware of Thunberg's earlier publication.

Lectotypification of *Drosera peltata*

Planchon (1848), assuming that Smith was the author of *D. peltata*, appears to have been the first person to lectotypify this species ("fide specim. anthent. [*sic* authent.] in herb. Smith nunc Soc. Linn. Londin"). In 1906, Diels also regarded the material in the Smith herbarium as the type for this species ("Smith—Original der Art!"). The material of *D. peltata* in the Smith herbarium (*Herb. J.E. Smith 557. 15-1*, LINN), which was available for study prior to 1798, was collected by *W. White s.n., anno 1793*, Port Jackson, New South Wales, Australia. Planchon's (1848) lectotypification was based upon the misinterpretation that Smith was the author of *D. peltata*. Since this specimen is not annotated by Thunberg (nor by Willdenow) it is assumed that he did not examine this material. As the type was not chosen from elements that were definitely studied by the author prior to publication, Planchon's lectotypification is here rejected (Stafleu *et al*, 1978, p. 75).

Since *D. peltata* has been circumscribed in various ways, in different parts of its range, the choice of a lectotype which preserves current usage (as recommended by Stafleu *et al*, 1978, Recommendations 7B.1) has presented some problems (refer p. 94). In any case, it has not been necessary to invoke the concept of usage since there is only one specimen which is suitable as the lectotype.

The material in the Thunberg Herbarium (*Herb. Thunberg 7720*) is a mixed collection of two specimens. One specimen (on the left side) has glabrous sepals, each with an irregularly toothed margin and narrow-cylindrical seeds. This specimen (clearly cut from another sheet) has been added to the existing sheet with the other specimen. However, there is no indication as to which specimen was in Thunberg's possession the earliest. The other specimen (on the right side) has hairy sepals. The seeds are not known. The protologue does not refer to the important diagnostic characters of the presence or absence of indumentum on the calyx or the shape of the seeds. However, it is quite clear which specimen should be chosen as the lectotype because Thunberg incorrectly described the inflorescences as umbellate ("Flores umbellati"). The inflorescence of the specimen with hairy sepals develops laterally amongst new leaves (fig. 1). It appears that Thunberg mistook these leaves with unopened blades for flower buds. Superficially, the arrangement appears to be an umbel. Furthermore, he states that the "umbella prolifera", which describes the actual inflorescence of this specimen. Therefore, the specimen with hairy sepals (on the right side) of *Herb. Thunberg 7720* (UPS) is here proposed as the lectotype of *Drosera peltata* Thunbg.

On the back of the *Herb. Thunberg 7720* sheet, directly behind the specimen on the

Herb. Thunberg
7720

7720



Fig. 1. *Herb. Thunberg* 7720 (UPS). A, lectotype of *Drosera peltata* Thunb.; B, an enlargement of the inflorescence and upper leaves of the lectotype (the specimen on right side of sheet).

right side, Thunberg has written "Ex nova Hollandia per Smith". This indicates that, at least one of the specimens was probably sent to Thunberg by Smith. However, there is no evidence at UPS or in Smith's correspondence (as held at K) that Smith supplied the name of *D. peltata*. Since the lectotype with its hairy sepals (on the right side) is structurally similar to *Herb. Smith 557. 15-1* (LINN), this LINN specimen is possibly an isoelectotype.

In addition, J.E. Smith appears to have sent a duplicate of W. White's collection to Jacquin (refer Diels, 1906) since the label and the back of the sheet of *Herb. Jacquin s.n.* (W) have written on them 'Smith' and 'Dr. Smith', respectively. This specimen is structurally similar to *Herb. Smith 557. 15-1* (LINN). However, the locality of this specimen is given as Botany Bay, not Port Jackson (refer Smith, 1805).

Since Willdenow (1798) has been frequently associated with the protologue of this species, it is useful to understand his concept of *D. peltata*. Willdenow only provided a brief description of *D. peltata*, including details of the flowers. The material in the Willdenow Herbarium (*Herb. Willdenow 6260*) is a mixture of material from J.J.H. de Labillardière and J.E. Smith (labels on back of sheet). Only one specimen (of the four) on the Willdenow sheet has flowers and the sepals of these are glabrous with irregularly toothed margins (Hiepko, pers. comm.). Therefore, the flowering material of *Herb. Willdenow 6260* (B) does not agree with the species concept of *D. peltata* as proposed by Smith (1805). There is no indication on *Herb. Willdenow 6260* as to which part of the material was from Smith and which from Labillardière. However, the flowering material was probably collected by Labillardière as it is similar to his illustration (t. 106, f. 2, 1805). If this is so, then it can be assumed that it was collected in Tasmania by Labillardière (Labillardière, 1805) and probably at Adventure Bay or Storm Bay (Nelson, 1974). Although the smaller specimens at the top of this sheet are sterile, these are structurally similar to the collections by White in *Herb. J.E. Smith 557. 15-1* (LINN). Therefore, it seems likely that these specimens were sent to Willdenow by J.E. Smith and can possibly be regarded as isoelectotypes.

If the flowering specimen of *Herb. Willdenow 6260* was collected by Labillardière, when was it sent to Willdenow? Labillardière received his material in Paris only late in 1796 and worked on it from 1797 (Nelson, 1974). Therefore, there was little time to send the material to Willdenow before 1798. Since the archives of the Botanisches Museum Berlin—Dahlem (B) were destroyed in 1943, it is not known at what time Willdenow received Labillardière's material (Hiepko, per comm.). Although it is possible that Labillardière's material may have been sent to Willdenow for identification after Willdenow's 1798 publication, I believe that it is more likely that he based his concept of *D. peltata*, at least in part, on this flowering specimen because he described the inflorescence (as a terminal raceme). Since the other three specimens are sterile, it is not possible to establish whether they are in accord with his description of this species.

Variation in *D. peltata* — *D. auriculata* Complex

Currently, the name *D. peltata* is applied to quite different variants in different parts of its wide geographical range. It was circumscribed by van Steenis (1933, 1953) as having glabrous sepals in the Malesian region, while in Australia, a number of authors, such as Black (1963) and Willis (1973) regarded this species as having hairy sepals. In New Guinea, I found that although the sepals are usually hairy, they may also be glabrescent, or sometimes glabrous.

D. auriculata is usually distinguished from *D. peltata* by the absence of indumentum on the sepals, the greater amount of branching of the styles, and by the narrower seeds. However, I have found a significant amount of variation in these characters, such that their usefulness, particularly at the specific level, is questionable. Firstly, under present concepts the sepals of *D. auriculata* are glabrous, each with their margin irregularly

toothed. However, in *D. peltata*, the sepals are glabrous with the margin of each varying from sparsely fimbriate to irregularly toothed (variation attributed to '*D. lunata*',—found in India, eastern Asia and throughout most of Malesia), sparsely hairy with margin fimbriate (*D. peltata* s. str., p.p.,—in most of Papua New Guinea and much of Australia) or densely hairy with margin fimbriate ('*D. foliosa*', '*D. gracilis*' and *D. peltata* s. str., p.p.,—in much of the Australian material and some of the Papua New Guinea specimens). Secondly, the amount of branching of the style is extremely variable in both taxa and does not appear to be useful taxonomically. Thirdly, the shape of the seeds of *D. peltata* varies from more or less ellipsoid (the usual shape) to oblong-cylindrical. When the seeds are oblong-cylindrical, they are difficult to distinguish from those of *D. auriculata* which are narrow-linear to oblong-cylindrical.

The degree of variability found within this complex is reflected in its taxonomic history. For example, the Labillardière material (t. 106, f. 2, 1805), the flowering material of *Herb. Willdenow* 6260 (B) and the glabrous specimen on *Herb. Thunberg* 7720 (UPS) represent the one taxon (*D. peltata* subsp. *auriculata* in this revision). Labillardière's material was excluded from *D. peltata* by Planchon (1848) and by J.D. Hooker (1855) and placed in *D. gracilis*. Bentham (1864) reduced this latter species to *D. peltata* var. *gracilis*. Diels (1906) referred Labillardière's material to *D. auriculata* while maintaining 'gracilis' as part of the variability found in *D. peltata*.

A number of authors (e.g. Planchon, 1848, Bentham, 1864 and Diels, 1906) have already emphasized that *D. auriculata* and *D. peltata* are extremely closely related. A thorough investigation of the two taxa throughout their geographical range has shown that the degree of overlap in these characters is such that *D. auriculata* and *D. peltata* are best regarded as conspecific.

If the presence or absence of indumentum on the sepals is used as a criterion for separating *D. auriculata* from *D. peltata*, then it is unjustified to maintain these two as separate species while regarding other species formerly recognised by minor characters, for example *D. lunata*, as synonyms of *D. peltata*. If we regard the shape of the seed as a fundamental feature to distinguish these two species, then some specimens which are at present classified as belonging to *D. peltata* (because they have hairy sepals), would have to be regarded as belonging to *D. auriculata*, even though their other features do not support such a separation. The presence or absence of indumentum on the sepals is of secondary importance and the variation in the shape of the seeds is such that there is too much overlap of character states to support maintenance at a species level.

The best solution, based on an assessment of the wide range of variation within population (e.g. as found in Australia and New Guinea) and accounting for the existence of distinctive sympatric populations (e.g. as found in Australia) in parts of the geographical range, is to recognise two infraspecific taxa on a combination of characters. The morphological differences observed between these two taxa represents infraspecific variation. Accordingly, *D. auriculata* is here reduced to a subspecies of *D. peltata*. The key to the subspecies summarizes the diagnostic features, while emphasizing the degree of overlap.

***Drosera peltata* Thunberg, Dissert. 2 (1797) 295.**

Lectotype (here proposed): *Herb. Thunberg* 7720 (UPS—specimen with hairy sepals on right side of sheet; Fig. 1A); possible iso. *W. White* s.n., anno 1793, Port Jackson, New South Wales, Australia, in *Herb. J.E. Smith* 557. 15-1 (LINN), the upper two smaller specimens on *Herb. Willdenow* 6260 (B) and *Herb. Jacquin* s.n., Botany Bay (W).

Synonyms: *D. lunata* DC.; *D. muscipula* Royle; *D. peltata* vars α *genuina* Planchon & β *gunniana* Planchon; *D. gracilis* Planchon; *D. foliosa* Planchon; *D. auriculata* Planchon; *D. lobbiana* Turcz.; *D. peltata* var. *typica* C.B. Clarke; *D. circinervia* Colenso; *D. stylosa* Colenso. (For full citation see under subspecies.)

Small herb, up to 47 cm high. *Stem* erect, simple or sometimes branched, glabrous, red, developed from a more or less globose subterranean tuber. *Stipules* absent. *Leaves* red, lower surface glabrous, upper surface with stalked glandular hairs, 1-6 mm long, the longer ones towards the margin; basal leaves in a rosette, often reduced, 4-12 mm long, not peltate, petiole compressed, up to 0.3 mm wide, wider than those of cauline leaves, blade orbicular, diameter 2-6 mm; cauline leaves peltate, 4-15 mm long, upper leaves of stem often in groups of 2-6, petiole (2-) 5 (-9) mm long, spreading or recurved, glabrous, blade suborbicular, lunate, diameter 2-3 mm. *Inflorescence* terminal or subterminal (if subterminal, then produced laterally from the distal nodes), ascending, 30-100 mm long; peduncle laterally compressed, (5-) 20-30 (-45) mm long, glabrous; (2-) 4-6 (-8)—flowered; pedicels laterally compressed, 4-12 mm long, glabrous (sometimes hairy at the base of the calyx in subsp. *peltata*); bracts narrow-lanceolate or lanceolate, c. 1 mm long, margin entire or serrate (in lanceolate bracts). *Sepals* ovate-elliptical, 3-6 x 0.5-1.5 mm, outer surface hairy to glabrescent with non-glandular marginal hairs, or glabrous with margin irregularly toothed. *Petals* obovate, 5-8 x 1.5-3 mm, white or pink, apex obtuse. Staminal filaments c. 3 mm long; anthers c. 0.4 mm long. Styles 3, 0.5-1 mm long, upper half usually several times divided. *Capsule* ovoid-ellipsoid, up to 3 mm long. *Seeds* narrow, linear to \pm ellipsoid, surface \pm scrobiculate, apiculate.

Distribution

This species occurs from Sri Lanka and Nepal, throughout S.E. Asia, to Japan and Australasia.

Key to the Subspecies of *Drosera peltata*

1. Seeds \pm narrow-ellipsoid, occasionally oblong-cylindrical, 0.3-0.5 mm long; basal unbranched part of style 0.1-0.2 (-0.3) mm long; sepals 2-4 mm long, hairy or glabrous; petals 5-6 mm long a. subsp. *peltata*
1. Seeds narrow-linear to oblong-cylindrical, (0.5-) 1 mm long; basal unbranched part of style 0.3-0.5 mm long; sepals (3-) 4-6 mm long, glabrous; petals (5-) 7-8 mm long ... b. subsp. *auriculata*

a. subsp. *peltata*

D. peltata Thunberg, Dissert. 2 (1797) 295; Willd., Sp. Pl. 1, part 2 (1798) 1546, p.p.; J.E. Smith, Exotic Botany 1 (1805) 79, t. 41; in Rees, Cyclops. 12 (1819); DC., Prodr. 1 (1824) 319; Sprengel, Syst. 1 (1824) 956; Wight & Arnott, Prodr. Fl. Penin. Indiae Orient. (1834) 34; Wight, Illust. Indian Bot. (1840) 43-45, t. 20, f. D; Planchon, Ann. Sci. Nat. Bot. sér. 3, 9 (1848) 296; J.D. Hook., Fl. Tasman. (1855) 30; Benth., Fl. Australiensis 2 (1864) 465; Kurz, J. Asiat. Soc. Bengal 45, part 2 (1876) 310; Clarke, in J.D. Hook., Fl. Brit. India 2 (1879) 425; Tate, Fl. Extra-tropical South Australia (1890) 20; Moore, Fl. New South Wales (1893) 33; Trimen, Fl. Ceylon 2 (1894) 146; King, J. Asiat. Soc. Bengal 71, part 2 (1902) 48; Rodway, Tasmanian Fl. (1903) 48; Diels, Pflanzenreich 26 (1906) 110; Dixon, Plants of New South Wales (1906) 41; Backer, Schoolfl. Java (1911) 474; Sulman, Wild-flowers of New South Wales 2 (1914) 59, t. 30; Merr., En. Philip. 2 (1923) 216; Ewart, Fl. Victoria (1931) 553; Steenis, Bull. Jard. Bot. Buitenzorg sér. 3, 13 (1933) 108; Vickery, Proc. Linn. Soc. New South Wales parts 3-4 (1933) 245, t. 8; Lloyd, Carnivorous Plants (1942); Backer, Bekn. Fl. Java, em. ed. 4 (1942) fam. 53; Black, Fl. South Australia, ed. 2, 2 (1948) 391; Steenis, Fl. Males. ser. 1, 4 (1953) 380; Acta Bot. Neerl. 2 (1953) 304; Fl. Males. ser. 1, 4 (1954) 599; Curtis, Student's Fl. Tasmania 1 (1956) 185; Gamble, Fl. Presidency of Madras 1 (1957) 320; Blackall, How to know Western Australian Wildflowers 1 (1959) 178; Haines, Bot. Bihar & Orissa 2 (1961) 359; Bakh. f., in Back. & Bakh. f., Fl. Java 2 (1965) 203; Eichler, Supplement, Black's Fl. South Australia (1965) 163; Galbraith, Wildflowers of Victoria (1967) 74; Erickson, Plants of Prey in Australia (1968) 44, pl. 11, f. 5 & 6; Cochrane, Fuhrer, Rotherham & Willis, Flowers & Plants of Victoria (1968) 122; Burbridge & Gray, Fl. Australian Capital Territory (1970) 190, f. 182A; Harris, Alpine Plants of Australia (1970) 86; Beadle, Evans & Carolin, Fl. Sydney Region (1972) 174; Willis, Handb. Plants in Victoria 2 (1973) 188; Wrigley & Fagg, Australian Native Plants (1979) 382; Conn, Brunonia 3 (1980) 213.

Type: Herb Thunberg 7720 p.p. (UPS—specimen with hairy sepals on right side of sheet), lectotype (refer p. 92).

D. lunata F. Ham. (née Buchanan) ex DC., Prodr. 1 (1824) 319; Sprengel, Syst. 1 (1825) 956; Hook., Icon pl. 1, 1 (1837) t. 54; Miq., Fl. Ind. Batavia 1, 2 (1858) 120; Forbes, Wand. (1885) 422; Wall. L.n. 1243; Mori, Enum. pl. Gorea (1922) 177.

Type: Herb. de Candolle, anno 1819, circa Sembu, Napalia (G-DC, microfiche seen).

D. muscipula Royle, Illustr. Bot. Himal. (1839) 75.

Type: n.v. (refer Notes, below).

D. peltata var. \propto *genuina* Planchon, Ann. Sci. Nat. Bot. sér. 3, 9 (1848) 297; *D. peltata* var. *typica* C.B. Clarke in J.D. Hook., Fl. Brit. India 2 (1879) 425; both varieties are *nomina invalida* (Stafleu *et al.*, 1978, Art 24.3).

Based on: *W. White* s.n., anno 1793, Port Jackson, New South Wales, Australia, in *Herb. J.E. Smith* 557. 15-1 (LINN).

D. peltata var. β *gunniana* Planchon, loc. cit.

Type: *Gunn* 448, anno 1842, Tasmania, Australia, in *Herb. Hook.* (K) (refer Notes, p. 98).

D. gracilis J.D. Hook. ex Planchon, loc. cit.; J.D. Hook., Fl. Tasmaniae (1855) 30, t. 5; Curtis, Student's Fl. Tasmania 1 (1956) 186.

Type: *Gunn* 784, anno? 1837, Tasmania, Australia, in *Herb. Hook.* (K) (refer Notes, p. 98).

D. foliosa J.D. Hook. ex Planchon, op. cit., p. 298; J.D. Hook., Fl. Tasmaniae (1855) 31, t. 6.

Type: *Gunn* 1027, 7.xii.1842, Formosa, Tasmania, Australia, in *Herb. Hook.* (K) (refer Notes, p. 98).

D. lobbiana Turcz., Bull. Soc. Imp. Naturalistes Moscou 27, part 2 (1854) 343.

Type: *T. Lobb* 364, s. dat., Singapore (?KW, ?LE, or ?Sing., n.v.).

Stem erect, (4-)5-17(-38) cm high. Sepals 2-4 mm long, outer surface hairy or glabrous, margin fimbriate and entire, less often irregularly toothed. Petals 5-6 mm long. Unbranched basal part of style 0.1-0.2(-0.3) mm long. Seeds \pm narrow-ellipsoid, occasionally oblong-cylindrical, ca. 0.5 mm long.

Distribution

This subspecies occurs from Sri Lanka and Nepal, throughout S.E. Asia to Japan, New Guinea and Australia. 160 specimens were examined.

Selected Specimens Examined

NEPAL: *Wallich* s.n., anno 1819, Napalia (SING 52160); *Stainton* 1201, -.viii.1956, Tuapabu Khola, Tamur Valley (L).

THAILAND: *Garrett* 377, -.vi.1927, Dei-Angka, Dei-Pa-Maio (L); *Sleumer* 4762, -.ix.1963, Loie; Phu Krading (L).

INDONESIA: Java: *Steenis* 11966, s. dat., Besoeki Djden, near Sempol (L); Bali: *Steenis* 7947, -.vii.1936, s. loc. (BRI); Celebes: *Bünnemeyer* 10940, anno 1925, Lombasang (L); Lombok: *Elbert* 1066, -.v.1909, Rindjani—Vulkangebierge N—Seite (L); Soemba: *Voogd* 1866, -.xii.1934, s. loc. (L); Timor: *Steenis* 18390, -.i.1954, Huato—Builico, NW of Mt Tatamailau (L).

PHILIPPINES: *Sinclair* 9743, -.vi.1958, Bokawan Road, above Guisab Valley (SING).

TAIWAN: *Tanaka & Shimada* s.n., 3.iv.1933, s. loc. (L 934. 288-262).

JAPAN: *Fukuoka* 6730, -.vii.1964, Mt Abuyama, Takatsuki city (L, SING).

NEW GUINEA: Vogelkop: *Brass* 9195, -.viii.1938, Lake Habbema (BRI); Western Highlands: *Hoogland & Pullen* 6032, 27.viii.1956, Tomba (CANB).

AUSTRALIA: Queensland: *McKee* 9274, -.iv.1962, Gorge Creek, W of Marceba on Dimbulah Road (BRI); New South Wales: *Borman* s.n., -.xi.1906, Orange (L 910. 190-1534); Australian Capital Territory: *Burbidge* 7603, -.xi.1966, Mt Gingera (BRI); Victoria: *B.J. & H.M. Conn* 705, 31.x.1979, Mt Korong, E of Wedderburn (AD); South Australia: *Whibley* 1552, 1.xii.1964, c. 2 km W of Balhannah, Mount Lofty Range (AD); Tasmania: *Gunn* s.n., s. dat., s. loc. (L 902. 149-237).

Notes

1. *D. muscipula*: There are several specimens at K which may refer to the type of this taxon. The original labels of one sheet which has two specimens read: "17/1 *Drosera muscipula*" and are credited as belonging to "Hb. Falconer". No collector's name or collection number is given. Another label referring to several specimens on the same sheet reads: "*Drosera lunata* Sm., N.W. India, Herb. Royle." Yet another specimen identified as *D. muscipula*, was collected by Madden from Muhasoo near Simla, in India.

Unfortunately, there is no mention of any plant in the protologue and the description is inadequate to comment further on which, if any, is the type material. There are no collections at LIV.

2. *D. peltata* var. *gunniana*: There are three herbarium sheets of *Gunn* 448 in Herb. Hook. at K. One reads: (a) "D. peltata 448/1842, Van Dieman Land, Gunn." On the same label in one corner is written "New Norfolk 2/11/39". Another herbarium sheet has two labels which read: (b) "Drosera peltata Sm. 448, Formosa, 4/11/43, very wet places." and (c) "D. peltata Sm. 448, Van Dieman Land, Penquite, 9/11/43." A third sheet has handwritten on the sheet: (d) "448, Van Dieman Land, Mr. Gunn." Since the protologue (Planchon, 1848) refers to "Formosa, Penguite (*sic* Penquite, see Burns & Skemp, 1961, map facing p. 18), New Norfolk; Gunn., no. 448, in herb. Hook.", the specimens listed above under 2(a), (b) and (c) are most likely to be the syntypes.

3. *D. gracilis*: There are three sheets with no. 784 in Herb. Hook. at K. One sheet has two labels which read: (a) "784/1837, Drosera gracilis J.D. Hook., Hampshire hills, 8/2/37." and (b) "Drosera gracilis Hook. f. 784, Nine ("or River") Marlborough, 1/2/45". The second sheet also has two labels which read: (c) "784/1842, D. gracilis, alt. 3388 ft., Arthur's Lake, 18/2/43, Tasmania." and (d) "Drosera gracilis Hook. f., 784, Marsh, Formosa, 4/11/44." The third sheet has one label with no. 784 on it and it reads: (e) "No. 784, Drosera gracilis Planch. Ann. Sci. Nat. III. 9: 297, Drosera peltata, Sm. Van Dieman's Land, R. Gunn, Sir W.J. Hooker, 1838." Since the protologue (Planchon, 1848) refers to "Van Dieman, loco dicto Formosa, ad Arthur's Lake alt. 3388 ped., Hampshire hills; Gunn no. 784", the specimens listed above under 3(a), (c), (d) and (e) are most likely to be the syntypes.

4. *D. foliosa*: There are two sheets in Herb. Hook. at K bearing the collection no. 1027. One sheet has three labels which read: (a) "1027, George Town, both sides of River, 23/10/44.", (b) "Drosera foliosa J.D. Hook., Van Dieman Land, Gunn, Tasmania, Fl. Tasmania, t. 6.", and (c) "D. foliosa J.D.H. 1027/1842, Formosa, 7/12/42."

The second sheet has a label which reads: (d) "1027 Drosera foliosa Hook. fil. Ann. Sci. Nat. III. 9. 298, Tasmania. R. Gunn, 1844." Since the protologue (Planchon, 1848) cites the type as "Hab. in insula Van Dieman loco dicto Formosa; Gunn, No. 1027 in Herb. Hook.", at least part of the first sheet is regarded as the type. It seems that the specimen which is referred to by label 4(c) is most likely to be the type.

b. subsp. *auriculata* (Backh. ex Planchon) Conn, *stat. nov.*

D. auriculata Backh. ex Planchon, Ann. Sci. Nat. Bot. sér. 3, 9 (1848) 295; J.D. Hook., Fl. nov.—zel. I (1852) 21; Handb. New Zealand Fl. (1864) 64; Benth., Fl. Australiensis 2 (1864) 465; Featon, Art. Alb. New Zealand I (1889) 33; Tate, Fl. Extratropical South Australia (1890) 20; Kirk, Student's Fl. New Zealand (1899) 146; Rodway, Tasmanian Fl. (1903) 47; Dixon, Plants of New South Wales (1906) 41; Diels, Pflanzenreich 26 (1906) 112; Cheeseman, Man. New Zealand Fl. (1906) 146; Laing & Blackwell, Plants of New Zealand (1907) 182; Cockayne, New Zealand Plants (1910) 113; Sulman, Wildflowers of New South Wales 2 (1914) 58; Cheeseman, Man. New Zealand Fl. (1925) 478; Black, Fl. South Australia 2 (1948) 390, f. 548; Curtis, Student's Fl. Tasmania I (1956) 185, f. 46; Allan, Fl. New Zealand I (1961) 202; Beadle, Evans & Carolin, Handb. Vasc. Plants Sydney District & Blue Mts. (1963) 149; Salmon, New Zealand Flowers & Plants (1963) 131, f. 408; Galbraith, Wildflowers of Victoria (1967) 74, t. 49; Cochrane, Fuhrer, Rotherham & Willis, Flowers & Plants of Victoria (1968) 122, t. 367; Erickson, Plants of Prey (1968) 47, figs 1-4; Harris, Alpine Plants of Australia (1970) 86; Burbidge & Gray, Fl. Australian Capital Territory (1970) 190, f. 182B; Hodgson & Paine, Australian Wildflowers (1971) 78; Garnet, Wildflowers Wilson's Promontory Natl. Park (1971) 134, f. 445; Beadle, Evans & Carolin, Fl. Sydney Region (1972) 174; Willis, Handb. Plants in Victoria 2 (1973) 188; Blombery, What Wildflower is That? (1973) 123, f. 319; Australian Native Plants (1977) 245, f. 129A; Wrigley & Fagg, Australian Native Plants (1979) 381.

Type: Backhouse *s.n.*, *s. dat.*, "Dros. petiolaris Sieb. Herb. No. 176", ?Sydney, New South Wales, Australia, in Herb. Hook. (K) (refer Notes, p. 99).

D. peltata Thunberg (as 'Sm. ex Willd.'): Willd., Sp. Pl. 1, part 2 (1798) 1546, *p.p.*; Labill., Pl. Nov. Holl. (1805) 79, t. 106, f. 2.

D. circinervia Colenso, Trans. New Zealand Inst. 26 (1894) 314, *nom. illeg.* (no Latin description—refer Stafleu *et al.* 1978, Art. 36.1).

Type: Anon. *s.n.*, anno 1885, Taupo, New Zealand (*n.v.*) (refer Notes, p. 99).

D. stylosa Colenso, *op. cit.* 28 (1896) 593.

Type: *H. Hills s.n.*, anno 1895, Ruahine Mountain-range, east side, New Zealand (*n.v.*) (refer Notes, p. 99).

Erect herb, (10-)20-30(-47) cm high. Sepals (3-)4-6 mm long, glabrous, margin irregularly toothed. Petals (5-)7-8 mm long. Unbranched basal part of style 0.3-0.5 mm long. Seeds narrow-linear to oblong-cylindrical, (0.5-)1 mm long.

Distribution

This subspecies occurs in the eastern states of Australia and on the main islands of New Zealand to a latitude of approximately 44°S. Approximately 180 specimens were examined.

Selected Specimens Examined

AUSTRALIA: Queensland: *Goy & Smith 445*, -v.1938, Camp Mountain (BRI); Australian Capital Territory: *Hartley 118*, 17.xi.1943, Black Mountain, Canberra (AD); Victoria: *Barker 1417*, 25.x.1971, c. 23 km SSW of Casterton (AD); *Phillips 299*, 29.x.1971, Foothslopes of Mt. Sturgeon, Grampians (AD); South Australia: *Alcock 2710*, 1.ix.1969, Ken Brinkworth Reserve, NW of Port Lincoln (AD); *Martensz 363*, 4.x.1970, Flinders Chase, Kangaroos Island (AD).

NEW ZEALAND: North Island: *Carrodus 38*, 26.x.1950, Day's Bay, Wellington (AD); *Chapman CHR 258642*, 22.x.1972, Wairoa-Gisborne Road (AD).

Notes

1. *D. auriculata*: In the protologue (Planchon, 1848), the type is cited as "*Dros. petiolaris* Sieb. Herb. no. 176 (in herb. Hook. cum speciminibus, *D. peltatae* commixta), non *D. petiolaris* Br." In Herb. Hook. at K, there are two sheets. One, which has two labels has (a) "*D. petiolaris* Sieb. *Drosera auriculata* J. Backhouse, Sydney, 9. nov. 1836." and (b) (which probably does not belong to the type) "*D. petiolaris* Sieb. var., Encounter Bay, S. Australia, Whittaker." (cited as one of the syntypes in the protologue). A second sheet has four labels, but only one concerns the type. This one reads: (c) "*Sieber Fl. Novae Holl. No. 176*". This latter collection is possibly the type.

2. *D. circinervia*: Type material of this taxon is not held at AK, K or WELT. Allan (1961) was also unable to locate any of Colenso's material.

3. *D. stylosa*: Type material of this taxon is not held at AK or WELT. One specimen at K (which has the name incorrectly spelt as "*D. tristylosa* Col") has a printed label which reads: "*New Zealand, Rev. W. Colenso. Presented, 1897*". This may represent the type of this taxon.

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DR H.H. BEHR'S TWO VISITS TO SOUTH AUSTRALIA IN 1844-45 AND 1848-49

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Abstract

This paper outlines the explorations and botanical endeavour of the famous German-American medico-naturalist, Hans Herman Behr, in South Australia (1844-45) and (1848-49). Five Appendices embrace the following topics: A, Chronology (1843-1855); B, Collection Localities; C, List of plants named after Behr and synonyms; D, Behr paper "On the vegetation at the Murray"; E, Two entomological excerpts.

Introduction

Dr Behr is probably the least known of all the famous German and United Kingdom botanists who came to South Australia last century, and an appraisal of his work is long overdue. All previous references to Behr in Australian scientific literature are brief and terse to the extreme. Even the eminent botanical biographer J.H. Maiden (1912) had little to say about him, apart from some short notes taken from Miss Alice Eastwood (1904), that he went to Australia in 1844 and returned to Germany in 1847. Three of the American source biographies are also partly inaccurate and quite misleading when referring to his work and travels during the period 1844-1850. It has therefore been necessary to correct some of the following statements; "From Australia Dr. Behr extended his travels to Java, the Straits-Settlements, the East Indies, and the Cape of Good Hope—always observing, collecting and describing." (Gutzkow et al., 1904)—"in 1847 he returned to Germany" (ibid.), and that in 1848, "—he gave up his practice and undertook his second great voyage, journeying first to Brazil and other countries of South America and thence to the Philippine Islands. There, in Manila he remained for the next two years, practicing medicine and exploring the country." (ibid.)—"In 1851 he came to California, which he never again left except in 1853, when he made a journey to Germany in order to bring his Polish bride, Miss Agnes Omylska to his San Francisco home." (ibid.).

Later, Essig (1931) really confused the issue by his statement that "On the recommendations of Humboldt he went to Australia in 1844 to study the aborigines as well as to collect and investigate in botany and entomology. He extended his travels and studies to Java, Straits Settlements, East Indies, and returned to Germany in 1848." Alice Eastwood (1904) also reflected that "he understood every language of Europe." He was undoubtedly a gifted linguist, but this would have been a daunting feat for any man. Nevertheless there is one point upon which the writer must agree with Miss Eastwood, that because Dr Behr never left any record of his writings, it is extremely difficult to trace his movements and activities.

The following account may therefore help to redress the confusion that has arisen about his overseas voyages, and provide a more accurate appraisal of the period 1844-1850, and life's work of this truly remarkable 19th Century scientist.

Biographical

Hans Herman Behr was born on 18 August 1818 in the German town of Koethen then the capital city of the principality of Saxony-Anhalt. According to one account (Anon., 1904a), "his father and grandfather held the office of councillor of the Prince and had jurisdiction over eleven villages with power to pronounce all sentences except death." At the Zerbst Academy he studied Greek, Latin, Hebrew and mathematics. It was about

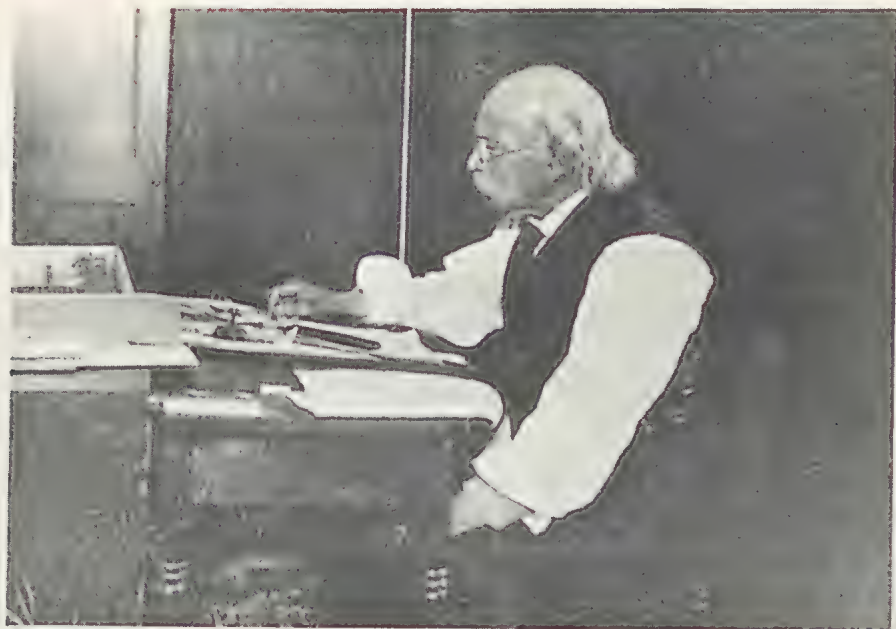


Fig. 1. Dr H. H. Behr, about 80 years old.

this time that he began to take an interest in the natural sciences "and he became an ardent collector of bird's eggs even stealing the nest of one of the royal swans to get a specimen for his collection." (ibid.). In 1837 he entered the University of Halle, and from there went to Würzburg to study medicine. At Würzburg, Behr became deeply interested in botany, and it was said what he learnt there about that discipline, "was the basis of his wonderful knowledge of the flora of the world which distinguished him above his contemporaries." (ibid.). Another side of his character, was his interest in the typical German student sport of duelling—fighting 27 duels for the student Club Moenania. (ibid.). On March 23 1843, he graduated as doctor of medicine from Berlin University, and then returned to Koethen where he practised medicine for a short time (Anon., 1904b).

Encouraged by his famous friends and mentors Karl Ritter and Alexander von Humboldt, Behr decided to embark on a voyage to Australia to further his knowledge in botany and entomology, being possessed of a special interest in the Coleoptera and the Lepidoptera. Subsequently, on May 27 1844, Behr left Bremerhaven on the ship, *George Washington*, bound for Australia; the vessel arriving at Port Adelaide on September 12 1844 (Anon., 1844a). The Colonial Newspaper 'Observer' (Anon., 1844b) gives a quaint account of this voyage as follows: "The *George Washington* arrived Thursday last, brings one hundred and eighty one steerage and two cabin passengers (H.H. Behr and E.F.G. Harzen). Six deaths occurred on the voyage, viz three adults and three children. There were also eight births. We understand the passengers present a very clean and respectable appearance. One of them became deranged at an early stage of the passage; and we are sorry to say he still continues in that melancholy state."

Behr then proceeded via Gawler to the Lutheran settlement of Bethanien (Fig. 2) and, by November 1844, was already despatching a letter to the Stettin Entomological Society about insect collections secured in the vicinity of Bethanien and the Barossa Range. On this first visit to South Australia Behr stayed thirteen months, exploring Pine Scrubs near

Gawler (Fig. 3), in the Spring of 1844; the Lyndoch district; Barossa Range throughout the Spring and early Summer of 1845; Light River during October, November 1844 and February 1845; Murray Flats July and August 1845; River Murray May 1845, and the River Onkaparinga (Schlechtendahl, 1847). He has nothing to say about his first excursion to the River Murray, but has left us with a fine account of his March 1849 journey.

One puzzling aspect is deciding where Dr Behr lived during his sojourn in the colony. Maiden thought he might have resided at Gawler, but there is no evidence to support this. On the other hand it is likely he boarded at the residence of Augustus Fiedler, a prominent landowner, orchardist and winegrower of Langmeil near Tanunda (19th century records, S.A. Dept of Lands). Behr secured a number of plant specimens from Fiedler's Section, and several interesting butterfly species from Herr Fiedler's citrus orchard at Bethanien (probably from Sect. 1, Hd Moorooroo, County Light). It is also possible that he might have boarded at Herr Buttner's Tanunda Hotel in Tanunda (Yelland, 1970). After completing his botanical reconnaissance of the Barossa Range and district, Dr Behr left Port Adelaide on October 9 1845; the sole passenger (except for Capitan Laun's wife), on board the small boat, *Heerjeboy Rustomjee Patell*, bound for Batavia and Amsterdam (Anon., 1845. The boat is named incorrectly as *R.H. Patel*. Dr Behr's name spelt as Dr Buhr). However on the voyage home the vessel was attacked in the Lombok Straits by pirates and forced to detour back through the Straits of Bali (Map 1), and take refuge at Banjoewangie, a port on the east coast of Java (Anon., 1904a). On 29 December 1845 the *Patell* loaded with a cargo of tobacco, sugar, gum d'Omar and vanilla sticks (Anon., 1846) sailed from Banjoewangie for Cape Town; arriving at Table Bay on 8 March 1846. The following day the *Patell* sailed for Amsterdam, reaching that city on 19 May 1846 (S. African Dept National Education, Govt Archives, Ref. C.C. 49, p. 141). From here Dr Behr presumably found his way overland to Koethen where he resided until the troublesome period of May and June 1848.

Behr spent the next two years in Germany, placing his natural history collections in order. He conveyed botanical material to Dietrich von Schlechtendahl who described many new species in the German periodical 'Linnaea', while some of his insect collections were dealt with by E.F. Germar (1848), a world authority on the Family *Coleoptera*. Meanwhile the political situation in Germany in 1848 was becoming more tense: Socialist revolutions in Prussia and Saxony, fanned by the events in France, stirred workers, students and some of the radical intelligentsia into action (Eyck, 1968). Behr was one of these, and so, to prevent his son's becoming more deeply involved in the revolution, Behr's father arranged for the young medico to take a second trip to South Australia (Anon., 1904a). Therefore, on 15 June 1848, Behr in his capacity as ship's surgeon was a passenger on the ship *Victoria* en route via Rio de Janeiro to South Australia. On November 6 1848 the vessel reached Port Adelaide, having been delayed by a blockade of the North Sea by a Danish naval squadron (Anon., 1848).

Once more Behr proceeded to Bethanien, traversing much the same country he had botanised in 1844-45. He was at Gawler by 21 November, and had apparently arrived at Tanunda two days later. Other areas explored by him included: Barossa Range November, December 1848 and January 1849; Salt Creek November 1848; Eastern side of the Mount Lofty Range November and December 1848; River Murray (Moorundie) March 1849; and 'Second half of the Murray Scrub' December 8 1848. On April 14 1849 he sent an important letter to Professor G. Kunze in Leipzig outlining the results of a recent visit he had paid in March and early April to Moorundie on the River Murray. This paper is notable not only for revealing Behr's astonishing knowledge of the Australian arid vegetation, but heralds the development of a fluent literary style, to appear so brilliantly later in novels and books (Behr, 1849).



Fig. 2. Sand scrub, Bethany sandplain. Section 42, Hundred of Moorooroo, County Light. (Photo. D. Krachenbuehl.)



Fig. 3. *Callitris* pine scrub. Willaston Cemetery, 2 km north of Gawler. (Photo. D. Krachenbuehl.)



Fig. 4. Dr H.H. Behr in middle life.



Fig. 5. Specimens of *Westringia rigida* collected by Behr in the Murray scrub and "above Salt Creek" (MEL). (Photo. D. Kraehenbuehl.)

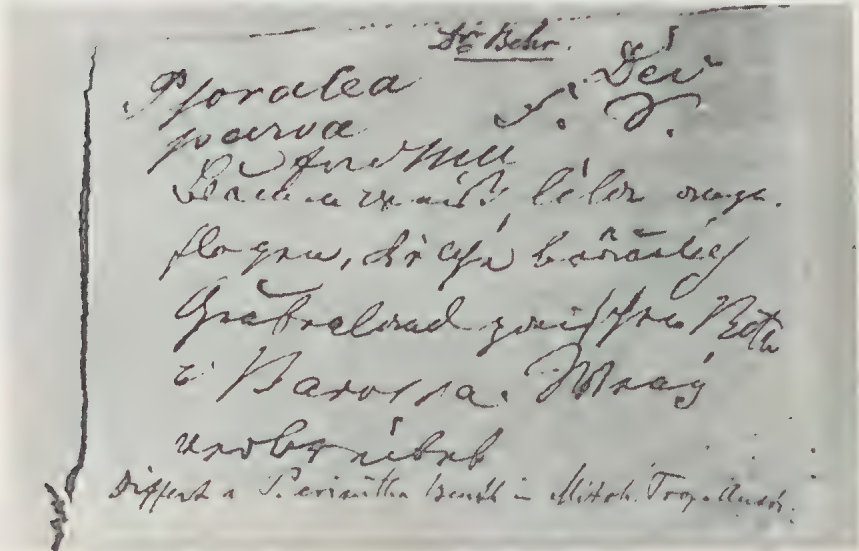


Fig. 6. A Behr plant label (MEL). (Photo. D. Kraehenbuehl.)

It was during this second stay in South Australia that Behr met Ferdinand von Mueller and William Hillebrand (later famous as Director of the Honolulu Botanical Gardens, Hawaii). Indeed there is slim evidence from herbarium labels that Behr and Mueller might even have co-collected in the Barossa Range and at Salt Creek, near Rosedale in November 1848. The date of Dr Behr's last departure from South Australia has eluded me: all I know for certain is that he accompanied William Hillebrand to Manila in the Philippines, sometime late in 1849, and that they both practised medicine there for a short time (Anon., 1904a), but according to Steenis-Kruseman (1974) no Asian collections are known. Dr Behr's arrival in Manila is confirmed by a short note in the 'Botanische Zeitung', that "news comes from Manila in the middle of December that Dr. Behr announces his intention of remaining there as a practising doctor, in order later to be able to continue his natural history investigations. His recent collections made in South Australia will probably be sent to Sir (William) Hooker in England." (Behr. 1850). But it seems his stay in the Philippines could not have been more than about seven months duration because Behr himself states in the Californian journal 'Zoe', that he first saw a *Malva* species in a garden of a Mr Tittell in San Francisco in September 1850 (Behr, 1891).

It is not my intention to elaborate too much about his activities in the United States, other than to say he lived in San Francisco for 54 years, was a member of the California Academy of Sciences in 1854, and a former Professor of Botany at the California College of Pharmacy in San Francisco (Essig, 1931). Possibly his most notable honour came in 1898 when this redoubtable old scientist had the honorary degree of doctor 'honoris causa' bestowed upon him by the Frederick William University of Berlin. "The presentation of the diploma was made the occasion of a magnificent function in Beethoven Hall on August 18, 1898; prominent citizens of all walks of life uniting to do him honour, and telegraphic congratulations being received from all parts of the world." (Anon., 1904b). He was the author of several books including 'The Plants of San Francisco', a novel about the Philippines, and a book of verse and nonsense 'The Hoot of the Owl.' He bequeathed most of his large Lepidopterous collections to the Academy; but it was regrettable that all these were destroyed in the disastrous earthquake of 1906. Hans Behr lived to the ripe old age of 85 years and six months, and died Monday March 6 1904, at his residence 1215 Bush Street (ibid.). Legge (1953) provides a particularly useful account of his work in California during the last half of the nineteenth century.

Several anecdotes gleaned from American sources lend a small insight into his character. First, when Behr settled in San Francisco he was accused by a Lutheran newspaper editor of being a Jesuit. "This vicious propaganda worked so effectively that his clientele—North German (and therefore Lutheran) grocers, butchers and tradespeople left him, and he was forced to move his practice elsewhere. He had his revenge by pointing sarcastic arrows which mutual friends never failed to wing to the target for which they were intended. For instance, discovering a particularly obnoxious louse, he named it after his enemy." (Gutzkow et al., 1904).

James Cottle a writer in 'Pan Pacific Entomology' says, "Let me state that Dr Behr was a very peculiar man. If you understood him, you might sail along like a ship before the wind in the most amiable manner. On the contrary, if you entered the Academy in that know-it-all, arrogant mode your dove-like voice would not be heard, your desired information or request would go by the board. G.O. Mueller, an old German friend of mine with whom I collected many years, once said to me 'Cottle what is the matter with Behr? If I am in your company I can see something' (referring to certain specimens he wished to see) but if I am alone he will show me nothing'. My answer was 'Mueller-you presume too much; do not cross him.' With me it was different. I knew but little regarding entomology and I always asked Behr's advice in any matter pertaining to it. If he advised

me as to where I could capture a certain species I would try and get it, and would remember him on my return." (Cottle, 1926).

Behr has been described as a man of good will and generous spirit, and that "his knowledge of men and affairs, together with the vast knowledge he had gained in far countries and strange places, made him the most companionable of men—(Anon., 1904b). A final tribute comes from Ewan (1953) who notes that "those who came to San Francisco from afar were sure to find Dr. Behr a hearty host, and it would be difficult to know how important was his influence in the lives of the many scientists and others that he chanced to meet."

Natural History Work in South Australia

Dr Behr was the first botanist systematically to collect and study the flora of the Barossa Range, mallee scrubs towards the River Marne (River Rhine) and areas adjacent to the River Murray at Moorundie (Fig. 7); but we do not know the full extent of his South Australian collections. Dietrich von Schlechtendahl (1847) treated 200 plants collected by Behr, of which he described 62 as being new species: a further five namely, *Loranthus exocarpi* (= *Lysiana exocarpi*), *Drosera rosulata* (= *Drosera whittakeri*); *Eucalyptus odorata*; *Correa schlechtendahliae*; and *Ionidium australasiae* (= *Hybanthus floribundus*), being described by Behr. Later Schlechtendahl (1847, 1848) treated an additional 25 Behr collections of which nine were described as being new to science. In 1958 the writer had the good fortune to locate a small remnant sand scrub of about five hectares in extent, on the sandplain northeast of Tanunda township. This area in part of Section 42, Hundred of Moorooroo, County Light, also lies only 2.5 km north of Bethany, and must have been very close to one of Dr Behr's type collection sites. Altogether 130 native plants occur here, including many of those species first described by Schlechtendahl.



Fig. 7. Ruins of Edward John Eyre's Aboriginal Station at Moorundie, River Murray, 1913. (Photo. courtesy of South Australian Archives).

Other Behr plant material has been described by Meisner (1848); Ferdinand von Mueller & Wilhelm Sonder (1853); several Rhamnaceae collections by Siegfried Reissek (1858); a number of *Eucalyptus* species by Mueller (1855); and F.A.W. Miquel (1856). Dr Behr's 1844-45 plant collections, including many types, are held at the Halle Herbarium, while the 1848-49 collections appear to be those which are incorporated within the large Sonder Herbarium; part of which was purchased last century by the Victorian Government, for the Melbourne Herbarium (Willis, 1949). Baron von Mueller had been urging the Colonial Government to purchase this very valuable Herbarium for many years, but because of their dilatory attitude towards the cost, a sizeable portion of the original Sonder material, remains today at the Institut fur Allgemeine Botanik, Hamburg (Stafleu & Cowan, 1976). Twenty seven South Australian plants were originally named after Behr, but these have been reduced to ten, namely; *Aristida behriana*, *Baeckea behrii*, *Eremophila behriana*, *Eriochlamys behrii*, *Eucalyptus behriana*, *Lasiopetalum behrii*, *Loudonia behrii*, *Prostanthera behriana*, *Senecio behrianus* and *Swainsona behriana*. It is also perhaps worthy to mention that Behr honoured his patron, and life-long friend, Schlechendahl, by naming a new *Correa* after him. The genus *Behria* (Liliaceae), endemic to Baja California, also recalls him.

Apart from his River Murray article, Dr Behr wrote an important paper "Ueber die Verhältnisse der Sud Australischen Flor im Allgemeinen." (later translated by Richard Kippist, Behr 1851) in 'Linnaea' (1847b), and two articles about South Australian aborigines, published in a German geographical journal (1848a & b), and an article on colonial life in South Australia in a German newspaper. Behr also contributed two entomology papers to the Stettin entomology journal (1845, 1847a), and though the scope of this present paper is biased towards botanical matters, I have included in Appendix E, two excellent summaries of his entomological researches.

In hindsight it is now apparent that Hans Behr paved the way for Ferdinand von Mueller and his fruitful explorations into the South Australian countryside. More is the pity that Behr never accomplished his intended visit to "the tip of Spencer's Gulf" near Melrose, or areas in the South East of the colony: all this he left to Mueller who fulfilled the task so brilliantly (Kraehenbuehl, 1971). Another curious fact that has come to light, is that in September 1849, Ferdinand von Mueller, Behr, William Hillebrand, William Blandowski and Ferdinand Osswald were all residing in South Australia; busily making plant collections, and extending knowledge of the colony's flora.*

Conclusion

One hundred and thirty five years have passed since Dr Behr accomplished his scientific reconnaissances into Barossa and Murray Mallee regions, and it is astounding that so much native vegetation has still survived. The fine Kaiserstuhl Conservation Park, proclaimed in 1978 reserves several important plant communities along the headwaters of Tanunda Creek, and despite a long history of grazing, the ravine of Tanunda Creek at Schlincke's Gully (Figs 8 & 9) is still aesthetically beautiful and wild in many places. Sandy Creek Conservation Park contains fine stands of Native Pine (*Callitris*) Woodland, and heath associations peculiar to the sand dune terrain of the Lyndoch region. But the former dense scrub of the Bethany sand plain is practically lost for ever to viticulture. Of all Behr localities in the Barossa Valley, that of Salt Creek has been most adversely affected by excess clearing along the creek, in scrub and open woodland; only small pockets remaining near hillsides.

*William Hillebrand and William Blandowski arrived in South Australia on September 14, 1849, on the vessel, *Ocean*. Blandowski later moved to Melbourne, and joined the staff of the Museum of Natural History. Ferdinand Osswald collected plants in the Barossa District and near Robe (South East District) around 1848; he was living at Kermode St, North Adelaide, at least until August, 1853. Osswald later resided in Nordhausen, Germany.



Fig. 8. View of Tanunda, 1938. Barossa Range in background, with Schlincke's Gully in the middle distance. (Photo. courtesy of South Australian Archives).



Fig. 9. View of Tanunda, 1938 (adjoining right side of Fig. 8). Mount Kaiserstuhl in the middle distance.

In the gorges and foothills along the eastern side of the Mount Lofty Range, where Behr secured several interesting *Acacia* species, a number of varied plant communities may still be observed, while further to the east, Moorundie Conservation Park near Blanchetown, has been established to conserve Hairy-nosed Wombat colonies and mallee plant associations adjacent to the River Murray.

If it were possible for Behr to survey the situation today, he would surely be delighted that future generations have been so eager to conserve natural areas throughout the Barossa and Murray Mallee regions. Way back in 1845, Dr Behr showed us the way: it is therefore vital that present generations of Australians must ensure our priceless heritage, and historic links with the past, are not just frittered away and destroyed for ever.

Appendix A

Chronology

- 1843: March 23, graduates as Medical Doctor from Berlin University.
- 1843-44: March to May 1844, residing at Koethen.
- 1844: May 27, departure from Bremerhaven on the *George Washington*.
- 1844: September 12, arrival at Port Adelaide, South Australia.
- 1844: Spring of year spent collecting in Barossa Range, Bethany and eastern side of Mount Lofty Range.
- 1844: November, writing from Bethany.
- 1845: January, collections from Mount Barker; May, collections from River Murray; July, August, collections from Murray Flats.
- 1845: October 9, departure from Port Adelaide on the *Heerjeboy Rustomjee Patell*, for Batavia, Netherland's East Indies.
- 1845: December, boat attacked by pirates in Lombok Strait.
- 1845: December 29, departure from Banjoewangi, east coast of Java, on *H.R. Patell*.
- 1846: March 8, arrival at Table Bay (Cape Town), South Africa. March 9, departure from Table Bay.
- 1846: May 19, arrival at Amsterdam, Holland, on *H.R. Patell*.
- 1846: Northern spring, arrival back in Germany.
- 1846-48: Spring to summer of 1848, medical practice at Koethen; natural history collections handed on to D. von Schlechtendahl and E.F. Germar.
- 1848: June 15, departure from Hamburg on the barque *Victoria*, via Rio de Janeiro. Political upheavals in Germany.
- 1848: November 6, arrival at Port Adelaide, South Australia.
- 1848: November 21, Gawler Town; Nov. 22, Gawler Town Pine Forest; Nov. 23, between Gawler & Lyndoch Valley; Nov. 23, Tanunda; Nov. 29, "Above Salt Creek"; "Second half of Murray scrub", Dec. 8.
- 1849: March, writing from Tanunda.
- 1849: Late March—early April; excursion to Moorundie, on River Murray.
- 1849: April 14, writing from Tanunda.
- 1849: Late spring, departure from South Australia for the last time, accompanied by Dr William Hillebrand. Precise date as yet unknown.
- 1849: Middle December, writing from Manila, Philippines.
- 1849-50: December—? August 1850, residing in Philippines as medico and natural history collector—assisted by Catholic clergy.
- 1850: ? August or ? September, arrival at San Francisco, California, U.S.A.
- 1850-52: Residing in San Francisco; member of famous Vigilance Committee.
- 1853: Return to Germany to bring back Polish bride Miss Agnes Omylska.
- 1854: Arrival back in the U.S.A., precise date unknown.
- 1854: February 4, member of California Academy of Sciences.
- 1855: Curator of Botany at Academy.

Appendix B

Collection Localities

- ANGAS PARK:** Old name for Nuriootpa, Barossa Valley township, 75 km north-east of Adelaide (Fig. 10).
- ANGASTOWN:** Former spelling of Barossa Range township, Angaston, 80 km north-east of Adelaide.
- BAROSSA:** Probably refers to the Hundred of Barossa, which takes in the scrubby area near Lyndoch.
- BAROSSA RANGE:** The northern spur of the Mount Lofty Range, c., 70 km from Adelaide.
- BETHANIEN:** See also *Between BETHANIEN and BAROSSA*: Modern name Bethany: small pioneer German settlement, 3 km east of Tanunda township.
- FIEDLER'S SECTION:** Prior to 1850, being Sections 1, 11 and 22 of the Hundred of Moorooroo, County Light. Section 1 bordering Tanunda Creek, and Section 11 adjacent to Chateau Tanunda Winery. Section 22 is located on the sandplain near Dorrien. Named after Augustus Fiedler of Langmeil (Tanunda).
- GAWLER RIVER:** See also *Towards the GAWLER and LIGHT RIVERS*. Formed by the confluence of the North and South Para Rivers which meet at Gawler.
- GAWLER TOWN:** Gawler, a large township, 40 km north of Adelaide.
- GAWLER TOWN PINE FOREST:** Remnant Native Pine (*Callitris preissii*) forests, in and surrounding Gawler.
- KOWI MANILLA:** Native aboriginal name for an unknown location along the River Onkaparinga, Mount Lofty Range. Precise location unknown.
- LANGMEIL:** Early German settled village, along east bank of Para River at Tanunda.
- LIGHT RIVER:** Large stream, c. 90 km north of Adelaide.
- LYNDOCH VALLEY:** See also *Between LYNDOCH VALLEY and GAWLER*: Old name for Lyndoch; small township, 56 km north of Adelaide (Fig. 11).
- MOORUNDIE:** See also various spellings viz: *MARONDE, MURONDI, MOORUNDEE, MOORUNDI*. Small location on River Murray 7 m South of Blanchetown, which is 135 km east of Adelaide.
- MOUNT BARKER:** See also *MOUNT BARKER DISTRICT BEI HAHNDORF*: Prominent hill in Mount Lofty Range, 32 km east of Adelaide.
- MURRAY FLATS:** Flat areas adjacent to the River Murray.
- MURRAY RIVER:** South Australia's largest river, located east of the Mount Lofty Range.
- MURRAY SCRUB:** See also *SECOND HALF of the MURRAY SCRUB* or *LAST HALF of the MURRAY SCRUB*. Apparently refers to that part of the Murray Mallee south of the modern Truro-Blanchetown highway, towards the River Marne.
- ONCAPARINGA RIVER:** The Onkaparinga River rises near Mount Torrens in the Mount Lofty Range, 48 km east of Adelaide.
- PFEIFFER'S SECTION:** See also *Between PFEIFFER'S SECTION and LYNDOCH VALLEY*: A difficult section to locate: probably somewhere close to Nuriootpa, for Wilhelm Pfeiffer was an early landholder at Angas Park and in 1876 as 'William' Pfeiffer his address was 'farmer Tanunda Scrub'.
- RHINE RIVER:** The River Marne which rises in the Eastern Mount Lofty Range 70 km east of Adelaide, and joins the River Murray at Wongulla.
- SALT CREEK:** Small stream between Rosedale and Sheoak Log, c. 13 km north-east of Gawler. Also known as Greenock Creek.
- SANDBERG:** An unknown locality, but may refer to either one of two areas viz: the high sand dunes near Lyndoch and Altona, or the high dunes at Moppa, north-west of Nuriootpa.
- SANDPLAIN, BETHANIEN:** Sandy tracts located about 3 km north of Bethany.
- SANDSCRUB:** Possibly refers to the above locality, or sandscrubs in the Lyndoch Valley.
- SCHLINCKEN'S THAL:** See also *SCHLINCKEN'S SCHLUCHT*. Schlincke's Creek is the upper ravine section of Tanunda Creek, near the Kaiserstuhl. It was named after Daniel Schlincke, flour miller of Bethany.
- TANUNDA:** See also *TONUNDA*: Large township in the Barossa Valley, 67 km north of Adelaide. The Kaiserstuhl (Mt Kitchener) is the large hill overlooking the town. I have seen no actual Behr plant collections from the Kaiserstuhl, although this is a familiar Ferdinand Mueller locale.
- TANUNDA CREEK:** Tributary of the Para River, which rises in the Barossa Range to the east of Tanunda township, about 75 km north of Adelaide.
- TORRENS RIVER:** Large river in the Mount Lofty Range, which rises 60 km from Adelaide, near the township of Mount Pleasant.



Fig. 10. Peppermint gum (*Eucalyptus odorata*) woodland, Angas Park (now called Nuriootpa). (Photo. D. Kraehenbuehl.)



Fig. 11. Altona Scrub, near Lyndoch. (Photo. D. Kraehenbuehl.)

Appendix C

List of Plants named after Behr

Names not currently accepted are printed in italics.

I have deleted *Halgania behrana* (= *H. littoralis* var. *glabrifolia*) from Maiden's (1907) list as this refers to *Halgania bebrana* F.v.M., named after Domina de Bebrana.

ASTERACEAE

Argyrophanes behrii Schlecht. = *Helichrysum baxteri* A. Cunn. ex DC.

Aster behrii Schlecht. = *Vittadinia blackii* N.T. Burbidge

Eriochlamys behrii Sond. & F.v.M. ex Sond.

Chrysocephalum behrianum Sond. = *Helichrysum baxteri* A. Cunn. ex DC.

Senecio behriana Sond. & F.v.M. ex Sond.

EPACRIDACEAE

Pentataphrus behrii Schlecht. = *Astroloma conostephioides* (Sond.) Benth.

FABACEAE

Lotus australis Andr. var. *behrianus* Tate = *Lotus cruentus* Court

Lotus australis Andr. var. *behrii* Moore & Betche = *Lotus cruentus* Court

Swainsona behriana F.v.M. ex J.M. Black

HALORAGACEAE

Loudonia behrii Schlecht.

LAMIACEAE

Prostanthera behriana Schlecht. (Fig. 12.)

MALVACEAE

Abutilon behrianum F.v.M. = *Abutilon theophrasti* Medic.

Lavatera behriana Schlecht. = *Lavatera plebeia* Sims

Malva behriana Schlecht. = *Lavatera plebeia* Sims



Fig. 12. *Prostanthera behriana*, Barossa Range. (Photo. D. Kraehenbuehl.)

MYOPORACEAE

Pholidia behriana F.v.M. = *Eremophila behriana* (F.v.M.) F.v.M.

MYRTACEAE

Calycothrix behriana Schlecht. = *Calytrix tetragona* Labill.

Camphoromyrtus behrii Schlecht. = *Baeckea behrii* (Schlecht.) F.v.M.

Eucalyptus behriana F.v.M.

ORCHIDACEAE

Caladenia behrii Schlecht. = *Caladenia* sp.*

Diuris behrii Schlecht. = *Diuris pedunculata* R.Br.

POACEAE

Aristida behriana F.v.M. (Fig. 13.)

PROTEACEAE

Grevillea behrii Schlecht. = *Grevillea ilicifolia* R.Br.

RHAMNACEAE

Cryptandra behriana Reiss. = *Cryptandra tomentosa* Lindl.

Trymalium behrii Reiss. = *Spyridium subochreatum* (F.v.M.) Reiss.

ROSACEAE

Acaena behriana Schlecht. = *Acaena echinata* Nees var. *echinata*

STERCULIACEAE

Lasiopetalum behrii F.v.M. (Fig. 14.)

THYMELAEACEAE

Pimelea behrii Schlecht. = *Pimelea octophylla* R.Br.



Fig. 13. *Aristida behriana*, Freeling, S. Aust. (Photo. D. Kraehenbuehl.)

*Bentham (1873) believed that *Caladenia behrii* was a form of *C. patersonii*.



Fig. 14. *Lasiopetalum behrii*, Murray mallee. (Photo. D. Kraehenbuehl.)

Appendix D

Extract from the 'Botanische Zeitung' 7 (1849) 873-876

Translation by Doris Sinkora, National Herbarium of Victoria

Travellers

On the vegetation at the Murray. From a letter by Dr Hermann Behr of Koethen (East Germany) to Prof. G. Kunze in Leipzig.*

Tanunda, April 14th, 1849**
(Received 12th November).

As far as I am concerned, I hope to complete the areas of the Gawler, Rhein, and the eastern scrub as far as the Murray shortly. I am only awaiting the coming spring in this district, before I'll move up north towards the tip of Spencer's Gulf. The present season is not exactly favourable for botanical explorations, travelling is made more difficult through lack of water, and I can tell a story [lit.: "sing a song"] about the tortures of thirst. Few plants are to be found in flower, and, those that are, can be found flowering just as well during any other season. Only the Loranthaceae and Santalaceae are contrary enough to develop their flowers right now, as does also *Calostemma* [*C. purpureum*] and along the Murray the beautiful *Crinum* [*C. flaccidum*]. I returned from there only a few days ago. In the plains and up to the springs of Light's Pass about the only thing found flowering was an occasional *Oxalis cognata* [*O. perennans*]. Otherwise the herbaceous

*See also: About the conditions of the South Australian Flora generally, by Dr H. Behr, *Linnaea* XX (1847) pp. 545-58.—Kze.

**In a letter written from there one month earlier the traveller expresses the hope to have completed the Barossa Range shortly, and then to be able to move further into the interior, to the Mt Remarkable area. Cultivation is already reducing much of the endemic flora.

flora of this stretch of country was withered and devastated by animals. Trees and shrubs showed the usual forms; the species of *Eucalyptus*, *Acacia retinodes* [and] *pycnantha*, *Exocarpus* [*Exocarpos cupressiformis*] and *Casuarina* [*C. stricta*], abundant in Angus Park, and the latter two formerly widespread around here, have now become isolated and rare specimens, because of the cattle which love the young foliage of these trees. This kind of vegetation continues with little variation, though less damaged by animals, right into the mountains, the grasslands of which extend across the water dividing range. However, from here on, as soon as the area, the river system of which already belongs to the scrub country, becomes more stony, *Santalum lanceolatum* [*S. acuminatum*], *Acacia cyclophylla*, [the hairy phyllode form of *Acacia rotundifolia*, abundant on the eastern side of the Mount Lofty Range near the River Marne and Cambrai], and their companions appeared. I found a Compositae new to me, related to *Cassinia* [this may be *Helichrysum bilobum*], a pretty shrub with white flowers.

The road to Maronde [= Moorundie] which I followed next morning after an improvised overnight camp in the scrub, leads for five hours, starting from the eastern slopes of the mountains, through plains which are covered with the low shrubs of a Compositae with white foliage [? *Cratystylis conocephala*]. From a distance this gives the impression—rather strange under the burning Australian sun—of snow-covered fields. Apart from a few species of *Salsola* [*S. kali*] and an occasional *Stenochilus* [*Eremophila* sp., probably *E. glabra* or *E. maculata*], it is difficult to find anything else, at least at this time of year. The white plain extends 'ad infinitum'. A black forest belt marks the horizon; at long last it is reached. But behind it, already visible through the sparse foliage of scrub *Eucalyptus*, glimmer once more the white shrubs of the plains. Thus it goes on, until finally the unbroken forest is reached. The black border along the horizon, which promised shade and coolness, spreads its thin, bare, snake-like twisted branches: it limits the view, and that is at least one advantage in the Murray Scrub! But one looks in vain for shade under the broken screen of its almost leafless crowns, through which a blue sky laughs down on the deceived wanderer. I did not find any plants here, but there was manna, to which my black friend Tujaemlurig drew my attention. I had the good luck to meet this aborigine on the way to Maronde [= Moorundie] and a native is always better than no companion at all. Referring to the manna: this is a kind of syrup which exudes from the leaves of some *Eucalyptus* species [could refer to a number of *Eucalyptus* species including *E. gracilis*, *E. oleosa*, *E. socialis* or *E. pileata*, which all occur in this region] and then dries in the sun, forming white patches on both sides of the leaves and on the stems. Permeated with the volatile oils in which these trees abound, it tastes very pleasant and refreshing, but strangely enough it is known to very few Europeans. Generally the scrub has far more such aids than one would expect, and to fully appreciate it one has to go to school with the aborigines first. Drinking water drips from cut-off roots, and deep in the wilderness one finds nests of Megapodius eggs [mallee fowl, native name mayerarko, still relatively common near Blanchetown and Waikerie]. It does not take long before one is as tired of the scrub as one is of the flats, and one greets joyfully the first clearing which shimmers from afar like a snowfield beneath the frame formed by the bare trunks, carrying foliage only high up in the crowns. These flats are, by the way, the most desolate spot I have found anywhere in the five continents on this earth. Other deserts impress with the vast expanse of desert meeting sky. But this small almost square spot, bordered by gloomy monotonous forests can give rise to no other emotion than that of never-ending boredom. After we had walked through the next forest, a flat of different appearance came into view. Here, too, were these white shrubs, but for a change they consisted of *Scaevola* [*S. ?spinescens*] and *Chenopodieae*. For contrast there is the black-green heathlike foliage of *Melaleuca curvifolia* [*M. lanceolata*] and the varied verdure—different shades of green amongst *Cassia* and *Stenochilus* and other shrubs. A beautiful *Loranthus* [? *Lysiana exocarpi*] with scarlet-red flowers hangs from a *Myoporum*-like

tree [Behr collected *M. platycarpum* towards the Murray in March 1849]. However, no grass at all is found here, though this is due rather to the herds of cattle, which are driven frequently through here from the Upper Darling, than to the poverty of the soil. But a fair distance from the road several species of grasses can be found, which cover the bright yellow sand here and there with their grey-green remnants.

According to my observations, the forest grows always on the barely noticeably elevated ridges, which run across the scrub. There the ground is very stony, and the subsoil seems to consist of solid limestone, of which large pieces are still entangled amongst the roots of uprooted trees that frequently lie across the roads.

The flats are always low-lying and are more sandy than rocky, and during the rainy season they are probably often swampy. The eastern plains, which are rich in vegetation, are formed in many places near mountains; they have stony soil, but are always slightly lower-lying than the forest belts running across them.

The plains of the Murray Scrub slope steeply down to the river valley. In most places this slope is so steep that it looks like a wall. The valley contains the floras of the scrub and the plains in colourful variety, and added to this are the plants of the lagoons [billabongs] and areas reached by floods. *Callitris* [probably *C. preissii*] grows here without its usual associates, and generally few plants agree with those of the western lowlands. A beautiful *Acacia* [possibly *A. stenophylla*, which is common here] with long, almost reed-like phyllodes, *Cassinia*, *Phyllanthus* [? *P. fuernrohrrii*] and *Melaleuca curvifolia*, as well as an *Exocarpus* [*Exocarpos aphylla*] like a leafless *Leptomeria*, form the characteristic features of an undergrowth above which nine *Eucalyptus* species as high as trees [but of bush-like growth] spread their thin crowns, a *Clematis* [*C. microphylla*] with long branches climbing through them. The land reached by the floods shows a partiality for Compositae; amongst them a few species of *Senecio* [*S. lautus* and, possibly, *S. behrianus*] in particular predominates in large numbers. A strange shrub grows here, with rod-like branches and flowers and fruiting capsules similar to *Euphrasia* [a very difficult plant to assess, but may refer to *Eremophila divaricata*, whose flowers superficially resemble a *Euphrasia*. *Eremophila divaricata* occurs at Blanchetown] also a *Morgania* [*M. glabra*] and a very lovely *Swainsona* [*S. greyana* or, possibly, *S. sericea*].

The edge of the lagoons is bordered by a kind of *Arundo* [*Phragmites australis*], which may not differ from *Donax*, and by *Typha* [*T. domingensis* and/or *T. orientalis*], *Micromaria* [probably *Mentha australis*, which Behr did collect on the Murray] and *Calystegia* [*C. sepium*] generally a vegetation very similar to the European, in which only a pretty *Sida* [*S. petrophila* is common] stands out. *Azolla* [*A. filiculoides* and/or *A. pinnata*], *Valisneria* [*Vallisneria spiralis*] and *Potamogeton* [*P. crispus*, *P. pectinatus* and *P. tricarinatus* are all common], float in the lagoons and in the river. A *Jussieuia* [*Ludwigia peploides*] trails along tree trunks that have fallen into the water, and an amphibious *Rumex* [probably *R. bidens*] with floating stem-like rhizomes sometimes forms artful garlands, at other times, when hidden under water, showing only foliage and buds. The growth of tall reeds, as tall as a man and covering large areas, which was previously recorded from here, has disappeared under the feet of grazing cattle. I hope to be able to tell you some more in a later letter about the other side of the riverbank, which is almost completely unknown, where the vegetation, as far as I have seen so far, seems to differ mainly in the predominance of *Callitris*. The natives from the Murray rarely enter there; but the desert plateau they enter only unwillingly, if ever. They speak of enemy tribes, who use magic and can change into birds; however a more plausible reason may be the charge of cannibalism which they make against the unknown inhabitants of the scrub. However, in my opinion the most certain enemies lying in wait there for the inexperienced traveller are hunger and thirst.

—Dr Hermann Behr

Appendix E

Two Entomological Excerpts

Translation by James A. Baines, Torquay, Victoria

Extract from 'Linnaea Entomologica' 3 (1848) 153-157

Contributions to the insect fauna of Adelaide, by E. F. Germar. Published by the Entomological Society of Stettin, in Posen and Bromberg.

Page 153.

Dr Behr, M.D, in Coethen, who in the spring of 1846 returned from New Holland, where he spent a year and a half in the vicinity of Adelaide as a naturalist, handed over to me the beetles he collected there, with the wish that I would examine and describe them. After comparing them with species from New Holland described by Erichson, Boisduval, Westwood, Kirby, Newman, Hope, Marsham and others, it was apparent that only relatively few were already known, and that on the whole the insect fauna of New Holland offers within limited local ranges greater differences than is the case in other countries.

Van Diemen's Land which lies about a hundred geographical miles further south, seems to have only a few species in common with the Adelaide district, for of 204 species of beetles which Erichson describes from this country [Archiv fur Naturgeschichte, Vol. 8, 1842] only eight have been discovered by Behr. It is striking that of the species that Newman described from the Adelaide area only very few were with certainty recognized in Behr's collection; however, Newman's descriptions are so insufficient that it is almost impossible to determine from them with certainty.

Page 154.

The diversity of insect faunas is due mainly to climate, vegetation, mountains and the nature of the soil, especially the mountains, which produce very remarkable variations, so that the entire character of the fauna is often altered by them, as for example in South America by the Andes and in Europe by the Alps. On the other hand there are other considerable mountain ranges that seem to cause only slight deviations, eg. the Apennines, the Pyrenees, the Urals. Inland New Holland is still too little known to draw conclusions from this circumstance about the character of the insect fauna, but great mountain chains cannot be presumed, and one cannot really say that the general nature of the New Holland insect fauna should be subjected to great changes, but only that the species change more quickly and establish themselves as opposites, than is found elsewhere. Dr Behr, in the 'Entomologische Zeitung', Part 6, 1847, communicated his remarks in reference to the occurrence of the insects, and his observations on the habitat of the separate genera I have embodied in the following (introductory) preample.

In the group of the Carabidae flattened forms predominate, which are found under the bark of eucalyptus trees, and though *Argutor* and *Steropus* were collected there, only *Promecoderus* was found in cow-dung. Most of the species came from Bethanien an old Lutheran colony north of Adelaide, where Behr spent the longest time. _____

Page 155. 2nd. last paragraph.

Behr brought with him very few species of *Brachelytren*, although it is accepted that this Family also has numerous representatives near Adelaide. Specially varying forms of these are however, in general not yet described from New Holland. _____

Page 156. last paragraph.

Of the families of Ptinioridae, Nitidularidae, and Dermestidae Behr brought so few species that they give no support for observations. _____

Page 157. middle of page.

Behr's communications have enriched the genus *Cryptodus*, formerly of only two species (*Cr. paradoxus* MacLeay, Westw. and *Cr. anthracinus* Erichs. Tasmanianus Westw.).

Extract from 'Archiv fur Naturgeschichte' 12 (1846) 198

A review of Natural History of the Insects published during 1845.

Editor, Dr Wilhelm Ferdinand Erichson. Published by Nicolai'schen Buchhandlung, Berlin.

On the butterflies of that district (Adelaide) Behr gave an account in a letter written from Bethanien (*Entomologische Zeitung*, p. 210). He likewise describes its fauna as remarkably poor. Among the day-flying butterflies is found a *Papilio* [*P. demoleus* or *P. anactus*], like *Demoleus*, and perhaps introduced with lemon trees, as well as a few *Pentus*, 3 *Vanessa*, 3 *Hipparchus*, and several *Lycaenidae*. Most interesting is a butterfly closely related to *Castnia*, which flies in the pine forest (the pine-tree of the settlers is *Callitris*) and resembles in colouring and behaviour our *N. parthenias*. The night fliers are richer in number by far; especially the tribe of *Microlepidoptera* is in no way inferior in richness of species to that of the European fauna. Isolated tropical forms crop up here, especially the huge *Hepiolus* [sic; should be *Hepialus*, Swift-moth] [*Hepialidae*] and an *Erebus*. (As the butterflies collected by Dr. Behr have been purchased by the Royal Collection of this country, I cannot complete the foregoing account.) The *Pontidae* are *Pieris aganippe* [*Delius aganippe*; *Pieridae*] and *Teutonia* Don., the *Vanessa*: *V. calybe* God. [*Precis villida calybe*], *Itea* F. [*Vanessa itea*; *Nymphalinae*] and an unnamed species very much like *V. cardui*; the *Hipparchus* are *H. (lasiommata) merope* F. [*Heteronympha merope merope*—of which both sexes have been counted as two different species—and *Singa* Boisd. Of *Lycaenidae*, there are 10 species; also 3 kinds of *Thymetus* were collected. The genus related to *Castnia* has recently been given the name *Synemon* [*Castniidae*] by Doubleday; Behr's collection included 4 species of it. Among the spiders are several forms peculiar to New Holland; even so, *Agaristidae* are not lacking (*A. latina* Don., *tristifica* Hub. and 2 species still unnamed)*.

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The author is also deeply indebted to Dr Hansjoerg Eichler for his initial encouragement 15 years ago, and useful suggestions regarding Dr Behr's movements in South Australia, and to Louis Velleman for shipping details, obtained personally by him in Amsterdam. Grateful acknowledgements are also made to Dr John Jessop and staff of the State Herbarium, Adelaide; Gaye Denny of the Adelaide Botanic Gardens library; staff of the Newspaper Reading Room Adelaide; State Library of South Australia; C.S.I.R.O. Library, Black Mountain, Canberra; and to the South Australian Archives for permission to reproduce photographs.

*A day moth, *Comocrus behrii* (*Agaristidae*) was named by George French Angas, who resided in South Australia during the 1840's.

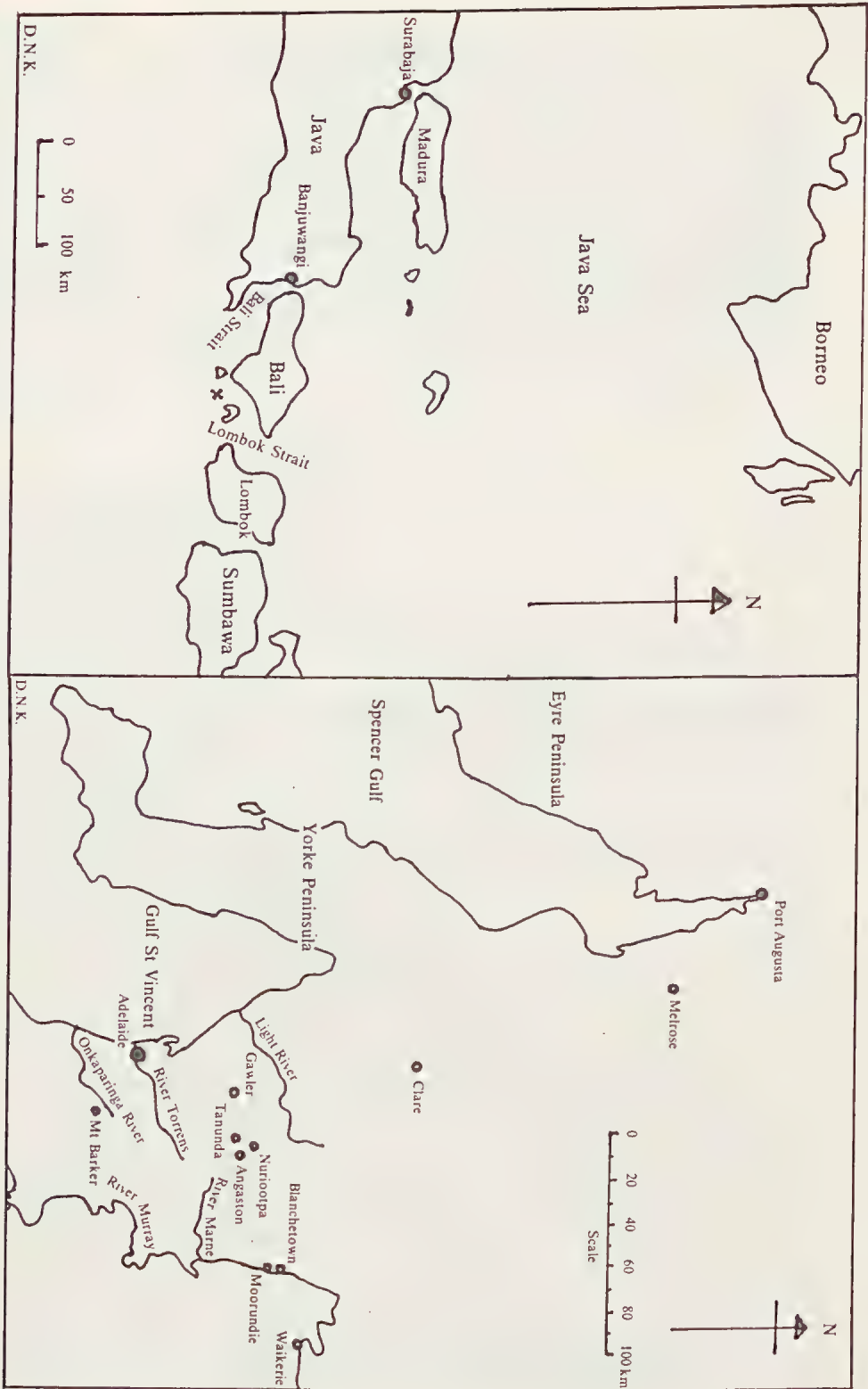
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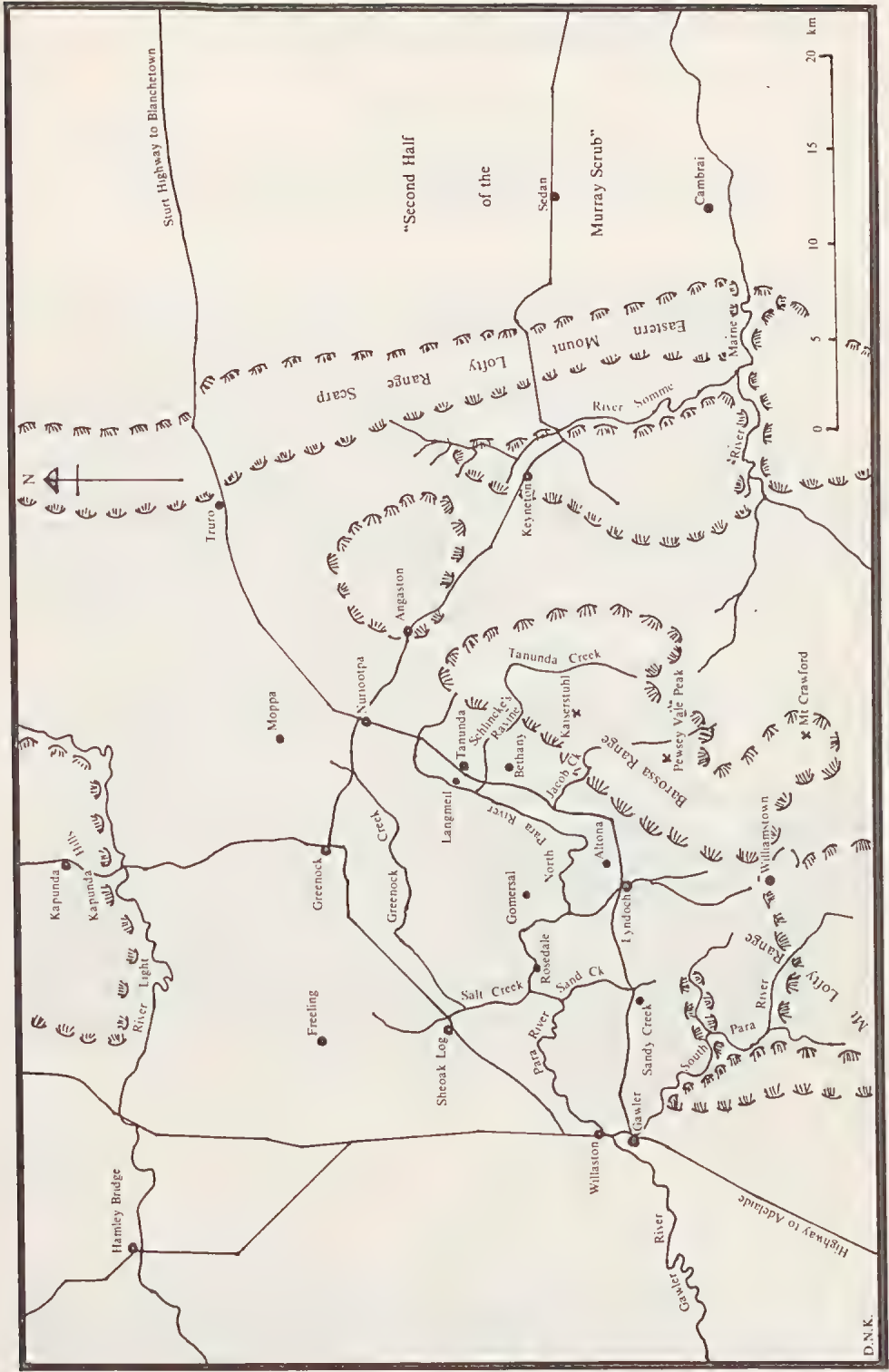
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Map 1. Part of Indonesia, showing where the *H.R. Patell* was attacked.

Map 2. Part of South Australia.



Map 3. Barossa and adjacent Murray mallee regions of South Australia.

TWO NEW COMBINATIONS IN *EREMOPHILA* R.BR. (MYOPORACEAE)

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Abstract

Pholidia sargentii S. Moore and *Halgania lehmanniana* Sond. are transferred to *Eremophila* and the necessary combinations effected. *Eremophila woollsiana* is reduced to synonymy under *Eremophila lehmanniana* (Sond.) Chinnock.

1. *Eremophila sargentii* (S. Moore) Chinnock comb. nov.

Basionym: *Pholidia sargentii* S. Moore, Journ. Bot. 59: 246 (1921).

Type: O.H. Sargent 793, Wongan Hills, Sept. 1917 (BM, PERTH!).

Although Grieve & Blackall (1975, p. 177) attribute this combination to C.A. Gardner as far as I am aware he never formally published it. This species was in fact omitted from his 'Western Australian Plant Census' (1931). Beard (1965, p. 121) included this species in *Eremophila* but incorrectly cited Spencer Moore as the authority. The only entry in 'Index Kewensis' for this species is in Supplement 7: 184 under *Pholidia*.

2. *Eremophila lehmanniana* (Sond. ex Lehm.) Chinnock comb. nov.

Basionym: *Halgania lehmanniana* Sond. ex Lehm., Pl. Preiss. 2: 238 (1848).

Type: L. Preiss 2336, York, 12.iv.1840 (MEL 80053!, 80054!).

Eremophila woollsiana F. Muell., Fragm. 1: 125 (1859).

Syntypes: Salt River No. 100 (MEL 77727); Fitzgerald River near Echo Glen 440 (MEL 83877).

Mr Kevin Kenneally, Western Australian Herbarium, who is revising *Halgania*, first drew my attention to this species as he considered that it was probably an *Eremophila*. The type of *E. lehmanniana* consists of three portions of stem with lateral branches containing leaves, calyces and a few gynoecia. There is no complete corolla but only a few fragments in a small envelope. Although Bentham (1868, p. 401) had not seen "*H. lehmanniana*" he considered, from the description of this species, that it was probably a form of *Halgania preissiana* Lehm. Superficially *E. lehmanniana* might resemble small forms of *H. preissiana* in the shape of the leaves and sepals but the type of hairs on the stem and leaves on this latter species are simple unlike the much branched dendritic hairs of *E. lehmanniana*.

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TWO NEW SPECIES OF POLYGALACEAE FROM CENTRAL AUSTRALIA

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Abstract

Comesperma pallidum and *Polygala isingii* are described as new. These names are used in the account of Polygalaceae in the handbook to the Flora of Central Australia.

***Comesperma pallidum* Pedley, species nova affinis *C. ericini* DC. foliis inflorescentiisque grandioribus et *C. sylvestris* Lindl. ramulis glabris foliis oblongis differt.**

Typus. Queensland: Mitchell District: Torrens Creek, March 1933, *White 8703* (BRI, holotypus; BRI, K, isotypi).

Frutex usque circa 2 m altus; ramuli angulatus glauci glabri vel raro sparsim puberuli. Folia subsessilia oblonga obtusa mucronulata 15-25 x 2.5-5 mm, 4-6.5 plo longiora quam latiora crassa costa sola conspicua. Inflorescentia aliquantum densa circa 6 cm longa; pedicelli circa 4 mm longi; bractei et bracteoli decidui. Flores eburnei ad carinae apicem purpurascens. Calyx: sepala externa \pm aequilonga, 1.4-1.6 mm longa, sepala interiora concava obtusa 4.2-4.7 mm longa. Corolla: carina 4.3-4.8 mm longa, alis longiora; alae 3.8-4.4 mm longae. Pistillum glabrum. Capsula 10-15 x 3.5-4 mm, retusa umbonata, sensim basin versus attenuata. Semina 2.7-3 mm longa, subcylindrica 1.2-1.5 mm diam., coma basem capsulae complenti.

Shrub to about 2 m tall; branchlets angular glaucous glabrous or rarely sparsely puberulous. *Leaves* subsessile oblong obtuse mucronulate, 15-25 x 2.5-5 mm, 4-6.5 times as long as wide, rather thick only the midrib prominent. *Inflorescence* rather dense ca 6 cm long, pedicels ca 4 mm long; bracts and bracteoles deciduous. *Flowers* cream, purplish on the keel. *Calyx*: outer sepals more or less equal in length, 1.4-1.6 mm long, inner sepals concave, obtuse, 4.2-4.7 mm long. *Corolla*: keel 4.3-4.8 mm long, longer than the wings, wings 3.8-4.4 mm long. *Pistil* glabrous. *Capsules* 10-15 x 3.5-4 mm, retuse umbonate, gradually narrowed to the base. *Seeds* 2.7-3 mm long, subcylindrical 1.2-1.5 mm diam., the coma filling the base of the capsule.

Specimens examined

NORTHERN TERRITORY: Central North. ca 28m miles (45 km) N of highlands Rocks (approx. 21°S, 130°E), vii.1970, *Maconochie 1083* (BRI, NT).

QUEENSLAND: Burke District. "Mt Sturgeon" Station, ii.1931, *Hubbard & Winders 7134* (BRI, K). Mitchell District. 10 miles (16 km) ENE of Torrens Creek, vi.1953, *Perry 3558* (BRI, CANB, K). South Kennedy District. Sandy forest tableland of the Suttor, *Mueller s.n.* (K).

Notes

The specific epithet alludes to the pale flowers and the overall pale appearance of the leaves of the plant when dry.

Comesperma pallidum occurs on sandy or gravelly soils in eucalypt communities on both sides of the Great Dividing Range in tropical Queensland and has been recorded as being rare in red sand in the Northern Territory. The *Mueller* specimen cited above was identified as *C. sylvestre* Lindl. by Bentham (1863, p. 146) and since then the species has usually been included with *C. sylvestre* which is restricted to areas of dissected sandstone in south-central Queensland.

Polygala isingii Pedley, species nova affinis *P. linariifoliae* Willd. a qua foliis late obovatis vel late oblongis hirsutis marginem versus differt.

Typus. Northern Territory: 5 miles S. of Mt Barkley, "Barkley" Station, 21°40'S, 132°30'E, iii.1971, *Latz 1224* (BRI, holotypus: NT, isotypus).

Misapplied name. *Polygala chinensis* var. *squarrosa* auct. non. (Benth.) Domin; Ising, Trans. & Proc. Roy. Soc. South Australia 81: 168 (1958).

Herba parva prostrata interdum dense ramosa globosaque; ramuli indumento pilorum longorum (1 mm) et breviorum curvatorum. Folia late obovata vel interdum late oblonga, obtusa retusave, 5-18 x 3-9 mm, 1.2-2.4 plo longiora quam latiora pilis longis patulis marginem versus praedita; petiolus 1-2 mm longus. Racemi pauciflori axillares pedicellis 1-2 mm longis. Flores 3-4 mm longi. Sepala pilis longis patulis; externa 1-1.5 mm longa, alae falcatae circa 4 mm longae. Corolla purpurea vel purpurea et flava; petala lateraliter obovata obtusa longitudine carinam aequantia leviter pubescentia ad adnationem tubi staminalis; carina 4-6 appendicibus unisquibusque iterum atque iterum furcatis. Filamenta staminum $\pm 1/3$ libera. Ovarium \pm oblongum emarginatum. Stylus curvatus apice hamosus stigmate intra curvaminem. Capsule interdum aliquantum asymmetrica, oblonga emarginata, 4-4.5 x 2.4-3 mm, ala pubescenti perangusta praedita. Semina nigra obovoidea circa 3.5 mm longa pilis albis rigentibus tecta; carunculus 3 brevibus appendicibus.

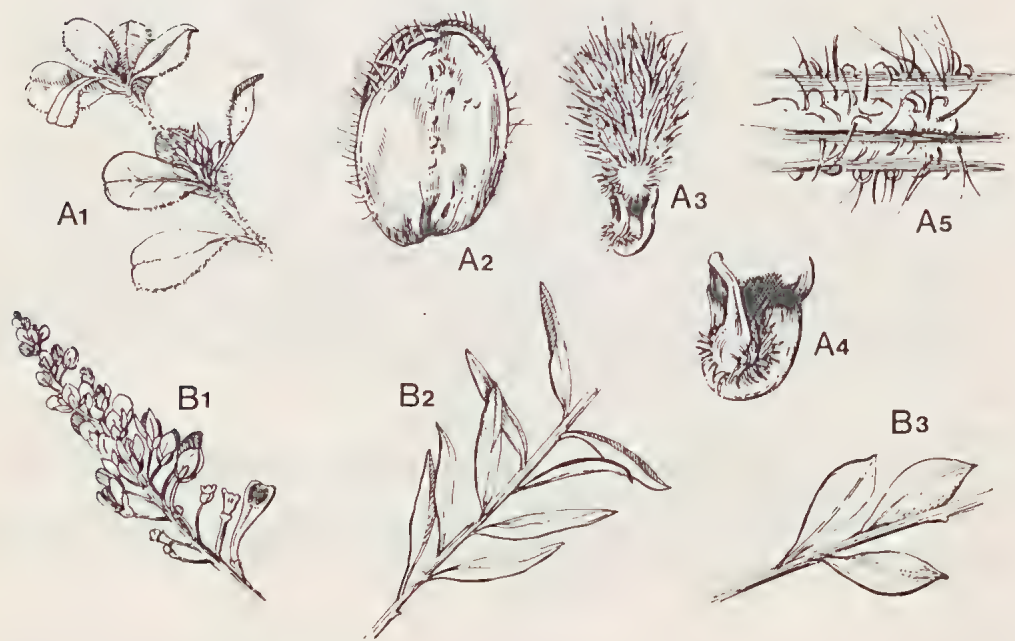


Fig. 1. A. *Polygala isingii*. A1, branchlet with leaves and inflorescence (x 1); A2, capsule (x 6); A3, seed (x 6); A4, caruncle (x 12); A5, branchlet showing indumentum (x 12). (All from holotype.)

B. *Comesperma pallidum*. B1, inflorescence (*Gittins 2495*); B2, branch with leaves (*Gittins 2495*); B3, branch with leaves (*Maconochie 1083*). All natural size.

A prostrate herb, sometimes densely branched and rounded; branchlets with indumentum of long (to 1 mm) spreading hairs and shorter curved ones. *Leaves* broadly obovate or occasionally oblong, obtuse or retuse, 5-18 x 3-9 mm, 1.2-2.4 times as long as wide, with long spreading hairs towards the margin; petioles 1-2 mm long. *Racemes* few-flowered, axillary; pedicels 1-2 mm long. *Sepals* with long spreading hairs; outer ones 1-1.5 mm long; alae falcate ca 4 mm long. *Corolla* purple or purple and yellow; lateral petals obovate obtuse, about as long as the keel, slightly hairy at the adnation of the staminal tube; keel with 4-6 appendages each of which is iterately forked. *Staminal filaments* free $\pm 1/3$. *Ovary* \pm oblong, emarginate; style curved, hooked at end with stigma inside the curve. *Capsules* oblong, emarginate, sometimes somewhat asymmetrical, with a very narrow hairy wing. Seeds black, obovoid, ca 3.5 mm long, with stiff white hairs; caruncle with 3 short membranous appendages.

Specimens examined

WESTERN AUSTRALIA: 4 miles (6 km) W of Dovers Hills, northern Gibson Desert, 23°06'S, 128°37', vii.1967, *George 9008* (PERTH); \pm 13 km SW of Well 35 (?39), Canning Stock Route, 21°50'S, 125°36'E, v.1979, *George 15652* (NT); 14 miles S of W end of Hopkins Lake, 24°26'S, 128°40', viii.1962, *Symon 2371* (AD); 81 miles [130 km] SW of Warburton Mission (approx. 26°55'S, 125°30'E), viii.1962, *George 2898* (PERTH).

NORTHERN TERRITORY: North Central. 10 miles [16 km] S of Rabbit Flat, 20°22'S, 129°55'E, vii.1973, *Latz 4060* (BRI, NT); between Tanami and The Granites (approx 20°S, 130°E), vii.1948, *Banks NT1929* (BRI); Lander Creek flood out area, 20°05'S, 131°37'E, iii.1973, *Henry 648* (BRI, NT); SE corner of entry to L. Surprise, Lander River [20°15'S, 131°55'E], iii.1973, *Maconochie 1670* (BRI); "Alcoota" Station, 22°58'S, 134°08'E, iii.1974, *Latz 4753* (NT); Undala Range, 15 km (10 miles) NW of Macdonald Downs, viii.1933, *Ising 3768a* (AD); Burt Plain, 36 miles [58 km] N of Alice Springs [23°10'S, 133°40'E], iii.1972, *Swinbourne NT8637* (NT); Mt Guide, "Tarlton Downs", 22°36'S, 136°52'E, v.1972, *Dunlop 2608* (BRI, NT). South Central. Mt Olga, 25°19'S, 130°43'E, viii.1973, *Latz 4137* (BRI); Kunoth Well, "Hamilton Downs", 23°30'S, 133°35'E, ii.1974, *Nelson 2341* (NT); Simpsons Gap National Park, 23°41'S, 133°43'E, iv.1974, *Latz 4900* (NT); 32 km S of Alice Springs, 23°56'S, 133°55'E, iii.1976, *Latz 6421* (BRI, NT); James Range, 24°19'S, 133°27'E, iv.1974, *Latz 4917* (BRI, NT); NW Simpson Desert, 24°37'S, 135°46'E, viii.1977, *Latz 7590* (NT).

SOUTH AUSTRALIA: Lake Eyre Basin. Evelyn Down, ca 120 km SW of Oodnadatta, x.1955, *Ising 3768B*.

QUEENSLAND: Gregory North District. approx. 47 km NSW of "Glenormiston" Station, 23°03'S, 138°29'E, ix. 1978, *Purdie 1365* (BRI).

Notes

The species is named in honour of Mr Ernest H. Ising (1884-1973) who made significant contributions to our knowledge of South Australian plants.

Polygala isingii is restricted to the 'Flora of Central Australia' region from about 125°E to 139°E in Western Australia, the Northern Territory and Queensland in the Lake Eyre Basin of South Australia. Though widely spread, it is evidently a rare plant usually found on gravelly or shallow soils on hills, but sometimes on sandy soil in hummock grassland.

The flowers of *P. isingii* are remarkably similar to those of *P. linariifolia* (see illustration in Adema, 1966) but the indumentum and broadly obovate leaves of the plant are quite different.

References

- Adema, F. (1966). A review of the herbaceous species of *Polygala* (Polygalaceae). *Blumea* 14: 253-256.
Bentham, G. (1863). "Flora Australiensis", vol. 1. (London: L. Reeve).

BOOK REVIEW

The third volume of the New Zealand Flora.

Healy, A.J. & Edgar, E. 'Flora of New Zealand', volume III: adventive cyperaceous, petalous & spathaceous monocotyledons.

The first two volumes of the 'Flora of New Zealand' dealt with the native species of dicotyledons and with the monocotyledons, except for the grasses. Volume 3 does not complete the native species. This is unfortunate in one way, but to the many who regretted the exclusion of the adventives from the earlier volume, the news is, nevertheless, good.

The authors write in their preface:- "Ultimately a complete Flora of New Zealand must encompass both native and adventive groups in the one treatment. This volume represents a transitional stage." The authors must be congratulated for making this change, even at this late stage, and for the way in which they have handled it. The keys to families include those families dealt with in volume 2 as well as those including adventives (surely the Gramineae should also have been included?). Similarly, in the keys to genera, in those families with both native and adventive genera, all genera are included and, in *Juncus*, *Carex* and other genera with native and introduced species, both the keys and the species treatments cover both categories of species. The problems of the user's not knowing whether a particular plant is native or naturalised are thus resolved.

The authors have adopted what they consider to be a fairly broad definition of an adventive species. Garden escapes, for example, are included if they have been collected more than once. They recognise 168 adventive species of monocotyledons (excluding grasses) to the 335 native species. This figure is certainly high compared with South Australia where comparable figures are approximately 80 to 375 in the third edition of Black's 'Flora of South Australia'.

The treatment of each taxon is similar to that adopted in the previous volumes—the descriptions being only slightly shorter than in volume 2. Synonymy, nomenclatural and taxonomic problems are not dealt with as fully as for natives. But the adequate notes do include both the first published record and the earliest known collection for both species, together with other notes such as made the earlier volumes so useful. There are 27 line drawings and 32 colour photographs. These are helpful although more would, of course, have been still better.

In the preliminary pages there are several useful sections: the continuation of the series of "Annals of taxonomic research on New Zealand [native] Tracheophyta" up to 1976, to which a subject index is appended; a list of authors of included taxa; a bibliography of first records of the adventive species dealt with; and a synopsis of orders, families and genera, including descriptions of the orders. There are three introductory keys, one to all the genera dealt with, one to the families and a mainly vegetative key to the families and some genera.

While I have not tested the keys exhaustively, they appear to be reliable and straightforward—if a little academic at times—the first lead of the generic key, for example, requiring floral characters which are very tricky in the Lemnaceae, Cyperaceae and several other monocotyledonous families. The text is accurate and I could find no typographical errors (except, possibly, for the author of *Watsonia bulbifera*, who was Matthews, not Mathews).

This volume maintains the high standard set in the previous volumes of the 'Flora of New Zealand' and, in breaking new ground by dealing with adventives as part of the flora constitutes an important reference work on this phytogeographically important area.

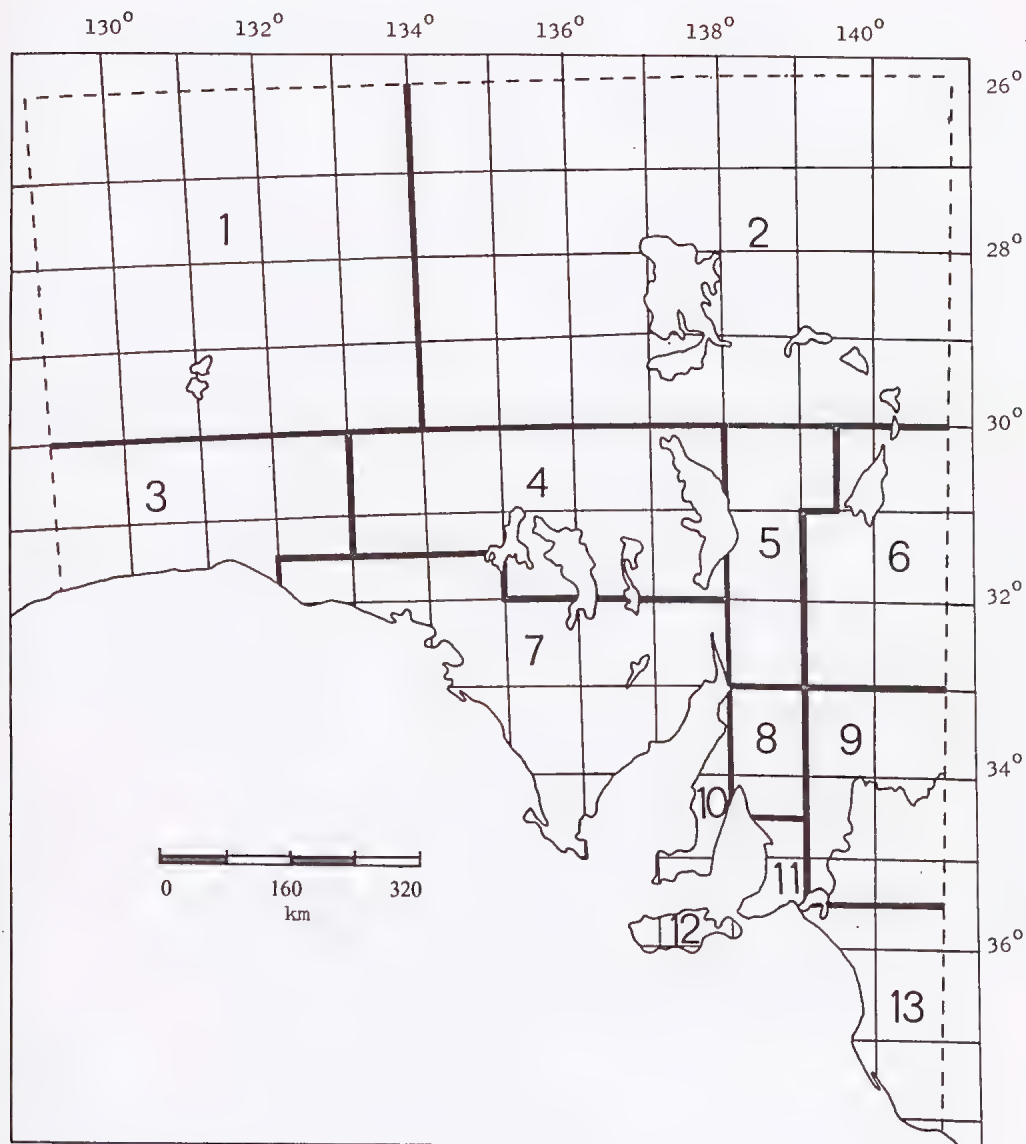
Healy, A.J. & Edgar, E. 1980. 'Flora of New Zealand. Volume III.

Adventive cyperaceous, petalous & spathaceous monocotyledons', pp. xlii, 220, 31 figs (4 col.), 4 maps (endpapers). (Published by P.D. Hasselberg, Government Printer, Wellington, New Zealand.)
Hard-bound NZ\$18.50.

J. P. Jessop
State Herbarium of South Australia

REGIONS OF SOUTH AUSTRALIA ADOPTED BY THE STATE HERBARIUM — ADELAIDE

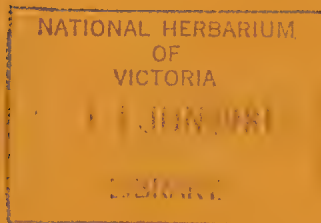
- | | |
|---------------------------|---------------------|
| 1. North-western | 8. Northern Lofty |
| 2. Lake Eyre Basin | 9. Murray |
| 3. Nullarbor | 10. Yorke Peninsula |
| 4. Gairdner-Torrens Basin | 11. Southern Lofty |
| 5. Flinders Ranges | 12. Kangaroo Island |
| 6. Eastern | 13. South-eastern |
| 7. Eyre Peninsula | |



JOURNAL of the ADELAIDE BOTANIC GARDENS

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JOURNAL of the
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Papers will be accepted in the following categories:

(a) Plant systematics (Australian and horticultural groups); (b) Descriptive plant morphology, anatomy and ecology; (c) Obituaries, biography and history; (d) Bibliographic studies, book reviews; (e) Botanical illustrations; (f) Noteworthy horticultural contributions.

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Smith, L. L. (1879). The species of *Danthonia* found in pastures in Victoria. *Austral. J. Bot.* 65: 28-53.

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Baker, J. G. (1898). Liliaceae. In Thiselton-Dyer, W. T. (ed.), "Flora of Tropical Africa", Vol. 7 (Ashford: L. Reeve).

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References may be cited as:

Benth., *Fl. Austral.* 4: 111 (1868) OR

Benth., *Fl. Austral.* 4: (1868) 111.

Citation of specimens

10-30 specimens should be cited for each species (or subspecific taxon), although this may be varied under certain circumstances. The author may decide whether or not to include dates of collections and the sequence, provided a constant pattern is adhered to throughout a paper.

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THE SOLANACEOUS GENERA, *BROWALLIA*, *CAPSICUM*,
CESTRUM, *CYPHOMANDRA*, *HYOSCYAMUS*,
LYCOPERSICON, *NIEREMBERGIA*, *PHYSALIS*, *PETUNIA*,
SALPICHROA AND *WITHANIA*, NATURALISED IN AUSTRALIA

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The University of Adelaide, Glen Osmond, South Australia, 5064

Abstract

Descriptions and distributions are given of the following Solanaceae in Australia: *Browallia americana* L., *Capsicum annuum* L. var. *annuum*, *C. annuum* var. *glabriusculum* (Dun.) Heiser & Pickersgill, *C. frutescens* L.; *Cestrum aurantiacum* Lindl., *C. elegans* (Brongn.) Schlecht., *C. nocturnum* L.; *C. parqui* L'Her.; *Cyphomandra crassifolia* (Ort.) Kuntze; *Hyoscyamus albus* L., *H. niger* L.; *Lycopersicon esculentum* Mill.; *Nierembergia hippomanica* Miers; *Physalis alkekengi* L., *P. ixocarpa* Brot. ex Hornem., *P. lanceifolia* Nees, *P. minima* L., *P. peruviana* L., *P. philadelphica* Lam., *P. pubescens* L., *P. virginiana* Mill., *P. viscosa* L.; *Petunia axillaris* (Lam.) B.S.P., *P. × hybrida* Vilm., *P. parviflora* Juss.; *Salpichroa origanifolia* (Lam.) Baill.; *Withania somnifera* L.

Introduction

This study was based on herbarium collections available in Australia. I have grown plants of *Capsicum*, *Petunia*, *Physalis*, *Salpichroa* and *Withania* for study purposes. Eleven genera of the family Solanaceae in Australia are considered. For the remaining genera with species naturalised in Australia, see *Datura*, Haegi (1976a), *Lycium*, Haegi (1976b), *Nicandra*, Horton (1979), *Nicotiana*, Horton (1981) and *Solanum*, Symon (1981, in press). *Atropa belladonna* L. has been grown as a drug crop, (Whittet, 1958, p. 351), or a garden novelty but it does not appear to be naturalised.

There are no recent collections of *Browallia*, only one of *Hyoscyamus* and few of *Nierembergia*. It seems doubtful if these genera are truly naturalised. However, common garden escapes tend to be poorly represented in herbaria (eg. *Lycopersicon*, *Cestrum*) and I am sure the specimens seen are an inadequate representation of the occurrences of many of these genera. I make a plea for more generous collection of garden escapes.

Key to genera of Solanaceae naturalised in Australia
(Adapted from Haegi (1981) *Telopea* in press)

1. Anthers dehiscing by terminal pores or short slits 2
- Anthers dehiscing by longitudinal slits running the full length of anther locule 3
2. Connective at back of anthers large and conspicuous 4. *Cyphomandra*
- Connective at back of anthers small, inconspicuous ¹*Solanum*
3. Stamens 4 4
- Stamens 5 5
4. Fruit a berry ²*Lycium*
- Fruit a capsule 1. *Browallia*
5. Fruit a capsule 6
- Fruit a berry 11
6. Capsule more than 2cm long, spiny or tuberculate; calyx base only persistent in fruit ³*Datura*
- Capsule less than 1.5cm long, more or less smooth; whole calyx persistent in fruit 7
7. Capsule opening by circular slit around circumference to form apical lid; fruiting calyx enlarged, teeth becoming spiny 5. *Hyoscyamus*
- Capsule opening from apex by longitudinal slits; fruiting calyx not or scarcely enlarged, teeth not becoming spiny 8

8. Woody shrubs; flowers yellowish ⁴*Nicotiana*
Herbs; flowers white to purplish 9
9. Corolla tube c. 1mm wide from base to mouth, then abruptly expanded into limb 7. *Nierembergia*
Corolla tube more than 1mm wide, gradually widening from base upwards 10
10. Calyx lobes fused for c. half their length from base with translucent intersepal membranes;
capsule opening from apex into 4, rarely 2 valves ⁴*Nicotiana*
Calyx lobes free more or less to base, lacking intersepal membranes; capsule opening from
apex into 2 entire or very shortly bifid valves 9. *Petunia*
11. Anthers with sterile terminal appendages; leaves deeply pinnatisect 6. *Lycopersicon*
Anthers entire, lacking appendages; leaves entire or lobed 12
12. Calyx enlarged in fruit, becoming longer than berry and enclosing it 13
Calyx not or scarcely enlarged in fruit, always shorter than berry 17
13. Mature berry red or black 14
Mature berry not red or black 15
14. Berry shining black; flowers purple-brown, more than 15mm long ⁵*Atropa*
Berry bright red; flowers greenish-yellow, less than 10mm long 11. *Withania*
15. Fruiting calyx lobes much longer than tube, auriculate at base; flowers blue ⁶*Nicandra*
Fruiting calyx lobes much shorter than tube, not auriculate; flowers purple or yellowish 16
16. Flowers in extra-axillary cymes, purple, fruiting calyx more or less globular, never ribbed ¹*Solanum*
Flowers solitary in leaf and stem axils, yellow, sometimes with dark markings; fruiting calyx
not globular, often ribbed 8. *Physalis*
17. Corolla stellate, lobes equal to tube 2. *Capsicum*
Corolla tubular, funnel-shaped or urn-shaped, lobes much shorter than tube 18
18. Spinescent shrubs with more or less fleshy leaves; flowers in axillary clusters; corolla
funnel-shaped ²*Lycium*
Non-spinescent shrub or climber, leaves not fleshy; flowers solitary in axils, or in leafy
sometimes congested panicles or racemes; corolla urn-shaped or tubular 19
19. Corolla urn-shaped; flowers solitary in axils; scrambling climber 10. *Salpichroa*
Corolla tubular; flowers in panicles or racemes; erect shrubs or small trees 3. *Cestrum*

1. BROWALLIA L.

L., Sp. Pl. (1753) 631; Gen. Pl. (1754) 278.

Erect, branching *herbs* to 1m (usually less). Pubescent with simple and glandular hairs. *Leaves* petiolate, simple, entire, sometimes geminate. *Flowers* solitary, axillary, *calyx* tubular, lobed, the lobes sometimes sub-foliose, exceeding the capsule. *Corolla* salverform, zygomorphic, the tube swollen at the apex, the mouth of the tube contracted, the *stamens* usually 4, a staminode or fifth anther sometimes present, didynamous. *Ovary* 2-loculed, ovules numerous, stigma expanded. *Fruit* a 2-valved capsule. *Seeds* numerous, minute.

A small genus of few species native to tropical America. One species *B. americana* L. is very variable and widespread. Originally cultivated as an ornamental annual, it is now naturalised in the Old World tropics. For consideration of the array of closely related genera and for the many synonyms for this species see D'Arcy (1973).

1. *B. americana* L., Sp. Pl. (1753) 631.

Type Citation: "Habitat in America australi"

Type Material: Not seen; D'Arcy (1973) gives "Hort. Cliff. BM, the original seed source was Panama".

¹To be published by Symon (1981, in press).

³See Haegi (1976a).

⁵See note in Introduction.

²See Haegi (1976b)

⁴See Horton (1981).

⁶See Horton (1979).

A very variable, erect *herb* to 1m, though usually less. Sparsely or densely pubescent with simple multicellular hairs, unarmed. *Leaves* to 7 x 5cm, more often c. 3.5 x 2 cm, ovate, apex acute to acuminate, base rounded, upper leaves often smaller and narrower. *Petiole* 5-10mm long. *Pedicels* erect, in the upper leaf axils. *Calyx* 10-12mm long, 4-5 partite, strongly angled, the lobe $\frac{1}{4}$ - $\frac{1}{3}$ of the total length. *Corolla* tube 1.5-2cm long, swollen on one side in the region of the anthers, the limb salverform, 10-15mm diam., shallowly lobed, shades of purple-blue or white, if coloured often with a contrasting pale centre. *Filaments* 4, didynamous, the upper pair very short, broad, attached to the rim of the tube, curved over so the broad filament substantially blocks the orifice of the corolla tube, the anther cells unequal, the upper reduced, the lower filaments attached further down, their apices inverted, the anthers with equal cells, style simple, the stigma flattened, elaborated and placed between the two sets of anthers. *Fruit* an erect capsule enclosed within the calyx. *Seeds* 0.75-1mm long, prismatic, minutely reticulate, numerous.

Note

The genus was first recorded as naturalised in Australia by White (1936) where it was described as a weed which is hard to eliminate. However, no other collections seem to have been made. White (1936) gives the extra information "Armstrong Creek near Dayboro; August 1934", but this is not on the surviving herbarium sheet. It was not possible to dissect the flowers of the single collection cited below.

Representative specimen

QUEENSLAND: *Mead s.n.*, s.d., Dayborough, becoming a pest in paddocks (BRI).

2. CAPSICUM L.

L., Sp. Pl. (1753) 188; Gen. Pl. (1754) 86.

Erect or spreading *herbs* or short-lived soft-wooded shrubs. Glabrous or sparsely pubescent with simple hairs. *Leaves* simple mostly entire, ovate or elliptic often geminate. Inflorescence of 1 or few pedicellate flowers from the leaf axil, often decurved at anthesis and erect in fruit. *Flowers* 5-partite. *Calyx* shortly tubular, truncate, the lobes short or reduced to marginal teeth or absent. *Corolla* deeply or broadly stellate, white or pale bluish, stamens equal, filaments inserted at the base of the corolla tube, *anthers* yellow or purplish, dehiscing by slits. *Ovary* 2-loculed, numerous ovules, style erect; stigma capitate. *Fruit* a dryish or sub-fleshy berry, mostly bright orange-red when ripe (less often purple, yellow or white). *Seeds* flattened, yellow or pale buff in colour.

A small genus of about 10-12 species originally from tropical America. Several species are very widely grown as chili, pepper, cayenne pepper, as a vegetable or pungent condiment. The numerous cultivars have received many names and only in recent times has the taxonomy approached stability. There is an extensive literature and still some disagreement on the application of names. For an earlier account of the cultivated peppers see Heiser & Smith (1953), for later accounts see Pickersgill (1971) and D'Arcy & Eshbaugh (1974).

The two species described here are closely related morphologically. D'Arcy (1973) states that herbarium specimens of *C. annuum* and *C. frutescens* may be indistinguishable. However, both species are consistently maintained by all recent workers on the genus and it is reported that their interfertility is low.

Key to *Capsicum* species

Adapted from D'Arcy (1973) and Gentry (1974)

1. Pedicels, two or more per node, after first flowering, rarely less, corolla white or greenish white, fruit ellipsoid-lanceolate or lanceolate 2. *C. frutescens*

- Pedicels, mostly one per node, after first flowering, rarely more, corolla white or bluish white,
fruit globose, ovoid or oblong-conical 2
2. Fruits large, mostly more than 1cm across (cultivated peppers) 1a. *C. annuum* var. *annuum*
Fruits small, less than 1cm across, mostly spontaneous forms 1b. *C. annuum* var. *glabriusculum*

1. ***C. annuum* L., Sp. Pl. (1753) 188.**

Type Citation: "Habitat in America meridionali.Ø"

Type Material: Not seen.

Solanum shanesii F. Muell., *Fragm.* 6 (1868) 144.

Type Citation: "Ad rivulos montium prope Rockhampton; Dallachy & O'Shanesy".

Type Material: "P. O'Shanesy 25.ii.1868, No.6 series 1, *Solanum* erect and slender 6-8 feet bark light coloured and slightly blistered, berry shining red $\frac{1}{2}$ " diameter, 2-celled, rare, not prickly, Rockh." (MEL 12404). Lectotype proposed here. *Dallachy* 435, 17 March 1865, fruit red, Rockhampton (MEL, K).

1a. ***C. annuum* var. *annuum***

Common Name: green pepper; red pepper; cayenne pepper; chili.

Annual or short lived *herb* to 1(-2)m, stems striate, glabrous or sparsely pubescent with simple hairs on young growth, in the leaf axils and at vein junctions below. *Leaves* to 10 x 5 cm, more often c. 6 x 3 cm, smaller on aged and distal twigs, ovate to broad lanceolate, acute to acuminate, base subcuneate, oblique, *petiole* 1-3cm long, narrowly winged above. *Flowers* solitary in leaf axil and stem forks. *Pedice* 1-1.5cm long. *Calyx* 3-4mm long, cupular, truncate, lobes minute. *Corolla* c. 1.5 cm diam., deeply stellate, the lobes triangular, white. *Filaments* c. 2mm long. *Anthers* 2-2.5 mm long, oblong, opening by slits, bluish. *Ovary* 2-2.5 mm long, ovate. *Style* c. 2mm long, erect; *stigma* small, terminal. Fruit an erect or pendant *berry*, ovoid varying greatly in size in horticultural cultivars, but usually greater than 1.5-2cm wide and long, at first ivory, then flushed purplish, finally bright red, sweet or pungent. *Seeds* 3-4mm long, flattened, yellowish.

Distribution

Widely cultivated as a crop and ornamental and occasionally persisting.

Notes

This description is based substantially on the form commonly grown in gardens as an ornamental and occasionally found spontaneous. Cultivars of the edible horticultural forms vary greatly in fruit shape and colour. They are frequently gross in size and flowers may be 5-7 partite. Peppers are very widely cultivated in temperate and tropical areas (e.g. Jessup, 1964).

Solanum shanesii F. Muell. is tentatively placed in synonymy here. It may be an early escape from cultivation particularly as the pedicels are reflexed, the berry globular and of moderate size. Almost all recent collections of naturalised *Capsicum* have erect fruits that are less than 1 cm diam., although they may be globular or ellipsoid. The syntype at K has been labelled *C. frutescens*, but the solitary pedicels would seem to exclude that species. A later collection (MEL 12402) has the label "O'Shanesy 1.ii.1869 Rockhampton. A deciduous shrub, flowers blue, petals reflexed, anthers yellow", which sounds more like a *Solanum* than a *Capsicum*. *S. shanesii* may represent the early stages of naturalisation.

Representative specimen

SOUTH AUSTRALIA: Symon 11570, 2.v.1979. Tasmore, Adelaide. Fruits at first ivory, then flushed purple, finally red (ADW, MO).

1b. *C. annuum* var. *glabriusculum* (Dunal) Heiser & Pickersgill, *Baileya* 19 (1975) 151-156.

C. hispidum var. *glabriusculum* Dunal in DC., *Prodr.* 13 (1852) 420. *Basionym.*

Type Citation: "*h* In Mexico circa Bejar (Berland. n. 1863 in h. Moric.); circa Tampico de Tamanlipas (Berl., n. 95 in h. Moric.)"

Type Material: Not seen. For discussion of the complex nomenclature involved see Heiser & Pickersgill (1975) and D'Arcy & Eshbaugh (1974).

Capsicum frutescens var. *queenslandicum* Domin. *Bibl. Bot.* 89 (1928) 1126.

Type Citation: "Nordost-Queensland: Regenwalder bei Harveys Creek (Domin. 1. 1910)"

Type Material: Not seen. Possibly at Prague.

Common Name: bird pepper.

An erect or sprawling short-lived *shrub* to 2m tall, stem somewhat ribbed, distal branches often widely forked. Glabrous except for minute appressed simple hairs on young growths and some long hairs on the veins below and tufts at the vein junctions. *Leaves* to 12 x 5cm but commonly about 6 x 3.5cm, further reduced on older distal twigs, ovate, entire, apex acute to acuminate, base rounded to cuneate, usually oblique, *petiole* 1-4cm long, often narrowly winged above. *Inflorescence* a solitary (rarely two) pedicellate flower from the leaf axil or stem fork. *Pedicel* 1.5-2 cm long. *Calyx* 2-3mm long, cupulate, truncate, the lobes minute. *Corolla* c. 1.5cm diam., deeply stellate the lobes triangular, white; *filaments* c. 1mm long; *anthers* c. 2.5mm long, oblong, opening by slits, bluish; *ovary* 2.5mm long, bluntly conical; style 4mm long, erect; stigma small, terminal. Fruiting pedicel 2-3.5cm long stiffly erect, slightly swollen above; calyx scarcely enlarged; *berry* 1-2.5cm long, from globose, ovoid to oblong-conical, less than 1cm diam., bright orange-red, extremely pungent. *Seeds* c. 4mm long, flattened, sometimes twisted, hilum prominent, about 20 seeds.

Distribution

Queensland, along the coast. Map 3.

Selected specimens (all cited)

NORTHERN TERRITORY: *Symon 8000*, 30.vi.1972, Darwin, in domestic garden. Growing up through shrubs to 2 m (ADW).

QUEENSLAND: *Griffiths s.n.*, Oct. 1887, Mackay (BRI); *Michael 887*, s.d., Mt Julian nr Proserpine (BRI); *Rodway Q4*, 24.xi.1927, North West Island, Capricorn Is. (NSW); *White 8836*, 26.iii.1933, Clevedon nr Townsville (BRI); *Brass & White 196*, 17.ix.1937, Daintree (BRI); *Everist 5078*, 16.v.1952, 14 miles N of Cardwell (BRI); *Symon 4746*, 17.v.1967, nr Redlynch on road to Mareeba (ADW, BRI, CANB); *Symon 4878*, 25.v.1967, Irvine Bank (ADW, BRI, CANB, K); *Baxter 1074*, Aug. 1968, North West Island (Pt Curtis dist.) (BRI); *Telford 968*, 27.v.1969, Coalstown Lakes, 25 miles E of Gayndah (ADW, CBG); *Lebler & Durrington 33*, 22.i.1970, junction of Barambak Creek and Burnett River, 5 miles NE of Gayndah (BRI); *Blake 23448*, 21.v.1970, Jansen Crossing, Endeavour R., SW of Cooktown (BRI, NSW); *Sharpe & Dowling 2287*, 27.iv.1977, Littabella Crk, 12 km N of Yandoran (30 km N of Bundaberg) (BRI).

NEW SOUTH WALES: *Powell s.n.*, May 1974, Gunnedah (NSW).

2. *C. frutescens* L., *Sp. Pl.* (1753) 189.

Type Citation: "Habitat in India."

Type Material: Not seen.

Common Name: bird pepper.

Herb or *subshrub* to 2m tall, sometimes woody below. Glabrous except for minute simple hairs on young points and in leaf axils. *Leaves* to 10 x 5cm, usually somewhat less particularly on distal shoots, ovate-lanceolate, apex acuminate, base subcuneate, often oblique. *Petiole* 1-3cm long. Flowers several, pedicellate from the leaf axil. *Pedicel*

1-1.5cm long. *Calyx* 2-3mm long, cupulate, truncate, lobes minute or absent. *Corolla* c. 8mm long, stellate, lobes triangular. *Filaments* c. 1mm long. *Anthers* 1.5-2mm long, oblong, opening by slits. *Ovary* 1.5-2mm long, bluntly conical. *Style* 3-4mm long, erect, slightly exceeding the anther; *stigma* small, terminal. Fruit an erect *berry* 1-1.5cm long, c. 5mm diam. narrow conical, fusiform or ellipsoidal, red, pungent. *Seeds* c. 4mm long, flattened, with slightly thickened margin, yellowish.

Distribution

Queensland, along the coast. Map 3.

Selected specimens

QUEENSLAND: *Nilsson s.n.*, Apl 1920, Kimguni via Mirani (BRI); *Seddon s.n.*, Apl 1932, Cudgen, Murwillumbah (NSW); *Johnson s.n.*, 26.v.1951, Buderim Mntn (NSW); *Speck 1735*, 24.viii.1963, 6 km N of Toorilla Hmstd, Pt Curtis (CANB, NSW); *Jones 3595*, July 1967, Mt Dryander, Proserpine (CANB).

3. CESTRUM L.

L., Sp. Pl. (1753) 191; Gen. Pl (1754) 88.

Woody *shrubs* or small *trees*. Glabrous or with simple or dendritic hairs. *Leaves* simple, entire, petiolate, sometimes geminate. *Inflorescence* axillary or terminal often a congested raceme or panicle. *Corolla* tubular, sometimes slightly zygomorphic, tube obconic or slightly inflated, lobes short. *Stamens* 5 mostly sub-equal, filaments inserted on corolla tube, variously pubescent, anthers included. *Ovary* on a small disc, glabrous, 2-loculed; *stigma* capitate, about the level of the anthers. *Fruit* a succulent berry. *Seeds* prismatic, embryo straight or curved in the endosperm.

A large genus with many species in both Central and South America, several of which have been widely cultivated as ornamentals. There has been no more recent monograph than that by Francey (1935-36), but three recent regional accounts deal with numbers of species: viz. MacBride (1962) 42 species; D'Arcy (1973) 20 species; Gentry (1974) 25 species. Bailey (1913) reported *C. nocturnum* L. to be naturalised in Queensland. It may have been a misidentification of *C. parqui* L'Herit. The following are also cultivated: *C. diurnum* L., *C. newellii* (Veitch) Nicholson, *C. psittacinum* Stapf, and *C. cultum* Francey, an apparent hybrid between *C. elegans* and *C. parqui*.

Key to *Cestrum* species

1. Flowers reddish; plants softly pubescent (densely so in region of inflorescence);
ripe berry red 2. *C. elegans*
Flowers greenish-yellow to orange; leaves only sparsely pubescent or glabrescent; berry
black or white 2
2. Corolla orange-yellow; ripe berry white 1. *C. aurantiacum*
Corolla greenish-yellow; berry black or white 3
3. Corolla tube 2-3mm wide below the lobes; filaments with an erect process;
ripe berry white 3. *C. nocturnum*
Corolla tube 3-5mm wide below the lobes; filaments without erect process;
ripe berry black 4. *C. parqui*

1. *C. aurantiacum* Lindl., Bot. Reg. 30 (1844) 71, n.65 and 31 (1845) t.22

Type Citation: "The Horticultural Society raised it from Guatamala seeds communicated by G.V. Skinner, Esq. and it lately flowered (August 1844) in the Chiswick Gardens. Its native place is said to be Chimalapa".

Type Specimens: Not seen.

Common Name: orange cestrum.

Large *shrubs* 3-4 m tall, sprawling, clambering and suckering. Sparsely pubescent on tips and new growth with minute crisped hairs, soon glabrescent. *Leaves* about 7-10 x 3.5-5 cm, elliptic, entire, apex acute to acuminate, base rounded to cuneate. *Petiole* 1-3 cm long. *Inflorescence* subspicate, racemose, axillary and terminal, of 10-15 flowers often congested towards the apex; most flowers subtended by a bract, leafy below, linear above, vespertine. *Flowers* sessile, *calyx* 5-8 mm long, tubular, calyx lobes 1-3 mm long, linear, the margin between the lobes ciliate, *corolla* tube 17-20 mm long, very slightly inflated above, lobes (5-6-7 in specimens to hand) 5 mm long, broadly triangular, inrolled during the day. *Stamens* 5, *filaments* c. 5 mm long, inserted about the middle of the tube and with a bluntly conical pubescent process at that position, sparsely and minutely pubescent below, slightly incurved just below the stigma; *anthers* 1.5 mm long before anthesis. *Ovary* glabrous, surrounded by a fleshy disc below, *style* 15-16 mm long, *stigma* 1-1.25 mm diam. capitate, dark green, slightly exceeding the anthers, included. Mature *fruit* reported 8-12 mm long, white, not seen.

Distribution

South eastern Queensland and coastal New South Wales. Map 1.

Note

C. aurantiacum is grown as a garden shrub and Maiden (1895) and Edgar (1933) reported it toxic to stock when animals were fed garden clippings. Beadle, Evans & Carolin (1972) report it naturalised about the Sydney region where it is proving difficult to control.

Specimens examined (all cited)

QUEENSLAND: *Hack s.n.*, 5.ii.1951, 'Roslyn', North Tamborine (BRI); *Wilcox s.n.*, 15.vi.1959, 'Logie', Tamborine (BRI); *Wood s.n.*, 7.vi.1963, West Cliff Rd, Tamborine (BRI); *Anon s.n.*, 17.ix.1951, Tamborine (BRI).

NEW SOUTH WALES: *Whittingham s.n.*, July 1912, Rydalmere (NSW); *Moylan s.n.*, May 1920, Greenwich (cult.) (NSW); *Glenfield Vet. Res. Stn s.n.*, 17.v.1933, Nowra (NSW); *Glenfield Vet. Res. Stn s.n.*, 20.xi.1937, Lismore (NSW); *Glenfield Vet. Res. Stn s.n.*, 16.v.1952, Gerringong (NSW); *Smith s.n.*, 18.v.1952, Gerringong (NSW); *McGuire s.n.*, 7.vii.1952, 29.vii.1952, Kurrajong North (NSW); *Constable s.n.*, 2.v.1957, Upper Cordeaux Dam (NSW); *Lambkin s.n.*, 24.vii.1972, Dumaresque Isl., nr Taree (NSW).

2. *C. elegans* (Brongn. ex Neumann) Schlecht., *Linnaea* 19 (1847) 261.

Habrothamnus elegans Brongn. ex Neumann, *Annales de Flore et de Pomone* Jan. (1844) 118. *Basionym*.

Type Citation: Not seen.

A woody *shrub* 2-3 m tall. Pubescent with simple, forked and dendritic hairs which are dense and purple in the region of the inflorescence. *Leaves* alternate, to 17 x 9 cm, commonly about 9 x 4.5 cm, broad lanceolate, entire, acuminate, base rounded, principal veins impressed above, conspicuous below; *petiole* 1-3 cm long, grooved above. *Inflorescence* a congested terminal panicle of subspicate racemes, one to three racemes from each leaf axil, lower flowers subtended by bracts. Bract 3-7 mm long, lanceolate, often coloured. *Pedicel* 0.5 mm long, or absent. *Calyx* tube c. 5 mm long, lobes c. 3 mm long, triangular acuminate. *Corolla* tube 2 cm long, c. 1.5 mm diam. at the base, 5 mm diam. just below the lobes, glabrous; lobes c. 4 mm long, long triangular, pubescent, strongly reflexed, close to *Spiraea* Red R.H.S. 025/1. *Filaments* 1 cm long, attached just below middle of tube, swollen, sparsely retrorsely pubescent above point of attachment, inflexed at summit; *anthers* 1-1.5 mm long, minutely papillose. *Ovary* 1.5 mm diam., glabrous, pink above, surrounded below by yellowish annular disc. *Style* c. 17 mm long, erect, minutely papillose above, *stigma* capitate, yellowish green, included but exceeding the anthers. *Berry* to about 1 cm diam. (but few seen), \pm globular, succulent, red.

Distribution

South eastern Queensland and southern Victoria. Map 1.

Specimens examined (all cited)

QUEENSLAND: *Jessup* 121, 9.vi.1978, Mt Glorious (BRI); *Everist, Teys & Knowles s.n.*, 4.vii.1962, Tamborine (BRI).

VICTORIA: *Kenny s.n.*, 1919, Williamstown (BRI); *Opie s.n.*, Apl 1977, Perrins Crk Rd, nr Beagley's Bridge (MEL).

3. *C. nocturnum* L., Sp. Pl. (1753) 191.

Type Citation: "Habitat in Jamaica, Chilli $\frac{h}{k}$ ".

Type Material: Not seen. D'Arcy (1973) cites Hort. Cliff. (BM).

Common Name: lady of the night.

Large *shrub* or small tree 2-4m tall, branches somewhat flexuose. Sparsely pubescent with crisped simple hairs mainly on young twigs and midribs of leaves below, minute glandular hairs also occur. *Leaves* to 15 x 7 cm, commonly c. 10 x 4 cm, alternate, lanceolate-elliptic, base rounded or broadly cuneate, apex acuminate. *Petiole* 5-10 mm long. *Inflorescence* of spike-like racemes, often congested, forming terminal leafy panicles. *Peduncles* to 9 cm long, mostly less. *Pedicels* to 3 mm long, upper flowers sessile, with reduced leafy or linear bracts 3-10 mm long. *Calyx* c. 2.5 mm long, campanulate, divided one third of the length into triangular lobes, all minutely puberulent. *Corolla* slender, slightly enlarged upwards, the lobes c. 4 mm long, inrolled during the day, vespertine, strongly scented at night, greenish yellow. *Filaments* c. 3 mm long, inserted high up the corolla tube, an erect process, sometimes bifid, projecting just below the point of insertion, the apex slightly incurved, the filaments minutely retrorsely pubescent where adnate to the tube. *Anthers* 0.5 mm long. *Ovary* with annular disc. *Style* 15-16 mm long, simple. *Stigma* shortly bifid exceeding the anthers. Fruit a *berry* 8-10 mm diam. hard or juicy, white. *Seeds* c. 4 mm long, somewhat flattened, prismatic, the outer face convex, the inner faces concave, the hilum scar oval, almost central, minutely reticulate.

Distribution

Sparingly naturalised in N.S.W. near East Maitland.

Note

This species is native to the Antilles and Central America and is widely cultivated throughout the tropics for its strongly night scented flowers. Maiden (1904) and Hindmarsh (1937) recorded *C. nocturnum* as poisonous to stock but this may have been a misidentification of *C. parqui*.

Selected specimen

NEW SOUTH WALES: *Lynch s.n.*, 5.ii.1974, East Maitland. Apparently native, scattered in back yards, etc. to 1-1.5 m high in large clump, flowers yellow (NSW).

4. *C. parqui* L'Herit., Stirp. Nov. fasc. 4 (1788) 73, t. 36.

Type Citation: Not seen.

Type Material: Not seen.

Common Name: green poison berry; Chilean cestrum; green cestrum.

Woody *shrub* to 2-5 m tall, suckering. Minutely pubescent with simple and short glandular hairs on new shoots and in leaf axils, glabrescent, hairs more abundant on corolla lobes. *Leaves* alternate, (2-) 3.5-5 (-6.5) cm, lanceolate, entire, apex acute to acuminate, base cuneate, tapering to the petiole, malodorous; *petiole* c. 1 cm long.

Inflorescence a congested terminal panicle of numerous flowers, lower flowers may have linear bracts. *Pedice*l 0.5 mm long or absent. *Calyx* c. 5 mm long, tubular, the lobes c. 1 mm long, triangular. *Corolla* tube c. 16 mm long, cylindrical, slightly expanded upwards, lobes c. 5 mm long, broadly triangular, pubescent on margins which are inrolled by day, greenish yellow, sweet scented, vespertine. *Filaments* c. 7 mm long, subequal, attached near middle of the tube, swollen and retrorsely pubescent in lower part; *anthers* c. 1 mm long, included. *Ovary* 1 mm diam. globular on a small annular disc, *style* 17-18 mm long, slender, *stigma* capitate. *Berry* 1-1.5 cm long, oval-ovate, shining, succulent, black. *Seeds* 3.5-4 mm long, prismatic, dark brown, about 10 per berry.

Distribution

In Queensland mainly in the south east, in New South Wales mainly along the coast, in eastern Victoria and the higher rainfall areas of South Australia. Map 2.

Note

C. parqui is toxic to cattle, sheep, horses and poultry, Rudd & White (1933), Lavers (1953), Everist (1974), Kleinschmidt & Johnson (1980). It is cultivated as a shrub, is spontaneous in suburban gardens (Adelaide) and is extensively naturalised. An extended account of this species in Victoria including map and illustration is given by Parsons (1973).

Specimens examined

NORTHERN TERRITORY: *Lendon s.n.*, 2.i.1976, Alice Springs, private garden (NT).

QUEENSLAND (selection of 35 examined): *Hubbard 2864*, 1.vi.1930, Kangaroo Point, Brisbane (BRI); *Beasley 88*, Mch 1934, Chinchilla (BRI); *Clemens s.n.*, Nov. 1945, Charleville (BRI); *Everist 3157*, 8.ix.1947, Lawes, 80 km W of Brisbane (BRI); *Webb 5212*, Oct. 1950, Brisbane (CANB); *Rawson s.n.*, 29.iii.1957, Blackbutt (BRI); *Quinn s.n.*, 16.v.1957, Mulgildie (BRI); *Klose s.n.*, 20.vi.1958, Toowoomba (BRI); *Marshall s.n.*, 14.iii.1961, Beechmont Mntn (BRI); *Lambley s.n.*, 18.iv.1961, Miles (BRI); *Everist s.n.*, 28.ix.1961, Wooroolin (BRI); *Diatloff s.n.*, 16.xi.1961, Boyland, nr Canungra (BRI); *Gillieatt bl*, 14.iv.1963, Mt Coot-tha, nr Bardon (BRI); *McDougall s.n.*, 4.x.1963, Kooralgin, Cooyar (BRI); *Gillieatt s.n.*, 15.vi.1964, Tech. Coll., Brisbane (BRI, CANB, MEL); *Holmes s.n.*, 9.i.1969, Dalby (BRI); *Lincoln s.n.*, 16.ii.1972, Roma (BRI).

NEW SOUTH WALES (selection of 20 examined): *Hindmarsh s.n.*, 10.x.1936, Grafton (NSW); *Bailey s.n.*, Mch 1939, Murwillumbah dist. (NSW); *Glenfield Vet. Res. Sin s.n.*, 20.i.1944, Albury (NSW); *Chopping s.n.*, Mch 1949, Balmain (NSW); *Arthur s.n.*, July 1950, Lismore (NSW); *Mactier s.n.*, 9.iv.1951, Moree (NSW); *Vickery s.n.*, 20.iv.1953, Clarence Riv., nr Lawrence (NSW); *Constable 5962*, 8.vi.1965, Aerodrome Mascot (NSW); *McBarron 15593*, 24.vii.1968, Flemington Saleyards (NSW); *Rodd 2276*, 12.xi.1972, Barranjoey (NSW); *Mansfield s.n.*, 20.xi.1974, Midkin South, Moree (NSW); *Waterhouse s.n.*, 13.v.1975, Nara Glen (NSW); *Barry 7*, 8.vi.1975, Barranjoey (NSW); *Burn s.n.*, 17.vi.1975, Maitland (NSW); *Pickard 3488*, 27.v.1977, 1 km SW of Minamurra (NSW).

VICTORIA: *Anon s.n.*, Apl 1940, King River Valley, Whitfield (MEL); *Cameron 7424*, 3.xii.1976, Iguana Creek Gorge, 1 km N of town of Iguana Creek (MEL).

SOUTH AUSTRALIA (mostly spontaneous in old gardens and waste places): *Dept Agric. s.n.*, 6.i.1939, Adelaide, Prospect (ADW); *Symon s.n.*, 25.v.1957, Adelaide, Ferryden Park, naturalised along conduits and drains of sewerage farm (ADW); *Clarke s.n.*, 1958, Mundulla via Bordertown (ADW); *Kain 130*, Oct. 1961, Spalding (ADW); *Symon 8452*, 21.i.1973, Kangaroo Island, abandoned garden, Hog Bay River farm (AD, ADW, CANB); *Symon 8814*, 16.v.1974, Burra, Paxton Square (ADW, B, CANB, K, MO).

4. CYPHOMANDRA Mart. ex Sendt.

Sendt., Flora 28 (1845) 161-176.

Trees, shrubs and vines, unarmed. Pubescent with simple, glandular or dendritic hairs. *Leaves* simple or compound, entire or lobed, often foetid, very variable within the genus, petiolate. *Inflorescence* of simple or branched racemose cymes often from a stem dichotomy. *Flowers* mostly 5-partite, *corolla* mostly deeply lobed, *filaments* free or connate extending into an elaborate connective at the back of the anther (one of the few distinctive features of the genus), anthers opening by pores or with longitudinal slits. *Ovary* with many ovules. *Fruit* a succulent berry. *Seeds* flattened, embryo circinnate.

An ill-defined genus of about 40 species badly in need of revision (Hunziker, 1979). The species are largely confined to the tropical mountainous regions of South America.

1. *C. betacea* (Cav.) Sendt., Flora 28 (1845) 172, pl. 6.

Solanum betaceum Cav., Icon, 6 (1800) 15, t. 524. *Basionym*.

Type Citation: "Habitat . . . h. Floret et fructificat in Regis horto Matritensi Julis et Augusto".

Type Material: Not seen, possibly MA.

Common Name: tree tomato; tamarillo.

A small *tree*, branching above, pubescent with minute simple hairs mixed with short glandular hairs, malodorous, clammy. Lower and juvenile *leaves* to 35 x 30 cm, commonly c. 15 x 12 cm, ovate, entire, apex acute to shortly acuminate, base cordate, basal lobes often overlapping. *Petiole* 5-15 cm long, terete. *Inflorescence* a pendulous cyme from stem fork or leaf axil. *Pedice*l 1-2 cm long. *Calyx* c. 5 mm long including the broad rounded lobes, densely glandular pubescent. *Corolla* c. 2 cm diam., deeply stellate, lobes cut almost to base, somewhat fleshy, pink, scented. *Filaments* c. 2 mm long, attached to base of corolla tube. *Anthers* 4-5 mm long, stout, erect, connective broad and thick along the back of the anther. *Ovary* bluntly conical. *Style* 5-6 mm long, stout, erect. *Stigma* not expanded at the apex. Fruit a succulent *berry*, 5-7 cm long, ovoid, dull dark red. *Seed* 3.5-4 mm diam., discoidal, the surface hirsute if not vigorously cleaned, shallowly reticulate-foveate, margin with a narrow wing, 0.25 mm wide, pale reddish brown, numerous.

Notes

The name *C. crassifolia* (Ortega) Kuntze, Revis. Gen. Pl. 3 (1898) 220, is used by McBride (1962, p. 12), Heiser (1969, p. 111) and *C. crassicaulis* (Ortega) Kuntze by D'Arcy (1973, p. 616), probably an orthographic error, are both based on *Solanum crassifolium* Ortega, Hort. Matr. Dec. 9 (1800) 117, which is a later homonym of *S. crassifolium* Salisb. (1796) and *S. crassifolium* Lam. (1797) and is thus illegitimate. The details are discussed by Sandwith (1938, p. 225). Several species have edible fruit and the one described here is now widely grown in warm temperate and upland tropical areas as a fruit. It is grown in all States in Australia with commercial plantings only in sub-tropical sites. For culture in New South Wales see Slack (1976).

Specimens examined (all cited)

QUEENSLAND: *Keys s.n.*, s.d., Blackall Range, naturalised (leaves only) (BRI); *Blake 1962*, 24.ix.1954, Mt Mobullan, Bunya Mtns, 1080 m, in rain forest (2 sheets) (BRI); *Douglas s.n.*, 16.viii.1956, Mooloo, S of Gympie in banana plantation (leaves only) (BRI); *Rudder 4081*, 26.ii.1965, State Forest Reserve 194, North Kennedy district (leaf only) (BRI).

NEW SOUTH WALES: *Clark, Picard & Coveny 1714*, 24.vii.1969, Yabbra State Forest, about 8 km S of Urbenville. (Leaves only, not seen) (NSW).

5. HYOSCYAMUS L.

L., Sp. Pl. (1753) 179-180.

Annual, biennial or perennial *herbs*, often viscid. *Leaves* alternate, often lobed. *Flowers* axillary in bracteate spikes or racemes. *Calyx* campanulate-tubular, 5-toothed, accrescent. *Corolla* broadly infundibuliform with 5 blunt lobes. *Stamens* inserted near base of corolla and \pm exserted. *Fruit* a capsule within the calyx, circumscissile. *Seeds* reniform to orbicular.

A genus of about 20 species distributed from Europe and North Africa to Central Asia. One species *H. niger* L. is cultivated as a source of the alkaloids hyoscyamine, scopolamine, and hyoscyne, see Hocking, *Econ. Bot.* 1 (1947).

Key to *Hyoscyamus* species

1. Cauline leaves sessile; corolla pale yellow with purple veins 1. *H. niger*
 Cauline leaves petiolate; corolla yellowish-white 2. *H. albus*

1. ***H. niger* L., Sp. Pl. (1753) 179.**

Type Citation: "Habitat in Europae ruderalis pinguibus".

Type Material: Not seen.

Common Name: black henbane.

A viscid foetid *annual* or *biennial* to c. 50 cm tall, erect or sparsely branched below. Stems, lower petiole, calyx base pubescent with long, simple, often glandular almost arachnose hairs, sparse and shorter elsewhere, leaf margin \pm ciliate. *Leaves* variable, lower leaves to 13 x 8 cm, ovate in outline, 2-4 triangular lobes on each side, apex acute, base sub-cuneate, *petiole* narrowly winged with decurrent lines on the stem, upper leaves smaller, more or less sessile and amplexicaule, leaves subtending the flowers entire, or with 1-2 lobes, somewhat narrower. Flowers subsessile in a dense unilateral spike each subtended by a leafy bract. *Calyx* at anthesis c. 1 cm long, tubular, with triangular lobes, apex acute. *Corolla* 2-3 cm diam. slightly zygomorphic, lobes rounded, pale yellow with conspicuous reticulate veins. *Filaments* attached to tube of corolla, glandular pubescent below, *anthers* 2-3 mm long, oblong, somewhat exserted, *style* curved, exceeding the anthers, *stigma* capitate. Fruiting calyx to 2.5 cm long, broadly urceolate, cartilagenous, veins reticulate, prominent, the lobes \pm divergent, pungent, *capsule* circumscissile. *Seeds* c. 1.5 mm long, sub-reniform, brown, minutely deeply reticulate.

Note

Eardley (1935) recorded this species in South Australia but there have been no recent collections.

Specimens examined (all cited)

NEW SOUTH WALES: *Humphrey s.n.*, Dec. 1906, Glenbrook (NSW); *Ward s.n.*, 22.i.1917, Sydney Bot. Gdn, cult. (NSW).

VICTORIA: The specimen mentioned by Willis (1972), *Willis 559* from near Kyabrum, has not been seen by me.

SOUTH AUSTRALIA: *Hutton s.n.*, May 1935, Jamestown, near stockyards (AD); *Eardley s.n.*, 17.vi.1935, Wolseley (fragment and drawing) (AD).

2. ***H. albus* L., Sp. Pl. (1753) 180.**

Type Citation: "Habitat in Europa australi".

Type Material: Not seen.

Common Name: white henbane.

Annual, *biennial* or *perennial*, about 50 cm tall, woody below, erect. Densely hirsute-pubescent with simple glandular hairs to 2 mm long particularly on the stems. *Leaves* reported 4-10 x 3-8 cm, orbicular-ovate, obtuse, cuneate to cordate at base, incise-dentate with rounded teeth. *Petiole* 1-5 cm long. Flowers sessile except the lowest, in dense unilateral spikes; bracts leaf-like. *Calyx* 1-1.5 cm long densely glandular-villous, teeth broadly triangular. Fruiting calyx swollen below, hypocrateriform above with short triangular pungent teeth. *Corolla* to 3 cm long, tubular-campanulate, somewhat zygomorphic, usually yellowish-white, throat greenish or purplish. *Stamens* included or slightly exserted.

Due to the inadequate local specimens the description is almost wholly from 'Flora Europaea'. There has been only one recent collection seen and it would seem highly likely that *H. albus* is not established in Australia.

Specimens examined (all cited)

QUEENSLAND: *Martin s.n.*, 13.x.1976, Sherwood, Alan Fletcher Res. Stn in a paddock (BRI).

VICTORIA: *French s.n.*, Oct. 1913, Williamstown (MEL); *McKerral s.n.*, 1882, Leigh River nr Warrambeen Station (leaf and flower only) (MEL).

TASMANIA: *Spicer s.n.*, Dec. 1876, nr Hobart Town (HO).

6. LYCOPERSICON Mill.

Mill., Gard. Dict. abr. ed. (1754).

Perennial sprawling *herbs* sometimes subwoody towards the base. Pubescent with simple or glandular several-celled hairs and abundant usually shorter glandular hairs, unarmed, aromatic. *Leaves* pinnately lobed or divided, smaller interstitial leaflets often present, leaflets sessile or stalked, entire or lobed. *Inflorescence* lateral, a several flowered racemose cyme or subpaniculate, pedicels articulate in the upper half. *Calyx* deeply divided, lobes lanceolate. *Corolla* 5-partite (6-9 in cultivars) stellate, yellow, filaments short, *anthers* erect, cohering in a tube about the style, dehiscing introrsely by longitudinal slits, each anther with sterile, conical terminal appendage. *Ovary* 2-loculed, with enlarged placenta (multi-locular in cultivars). Fruit a *berry* generally red. *Seeds* compressed, pilose, embryo coiled.

A small genus centred on the Pacific coast of western South America (Chile to Colombia) and extending to the Galapagos Islands. The ten or so species are closely related to the genus *Solanum*.

1. ***L. esculentum* Mill.**, Gard. Dict. ed. 8 (1768).

Type Material: Not seen.

Solanum lycopersicum L., Sp. Pl. (1753) 185; Domin, Bibl. Bot. 89 (1928) 1126.

Common Name: tomato.

Sprawling short lived *herb* 50-150 cm tall. Often densely pubescent with simple and glandular hairs, clammy, aromatic. *Leaves* to 30 x 20 cm, ovate in outline but deeply pinnatisect into 7-9 major lobes which are petiolulate, the lobes themselves entire or with petiolulate or sessile lobes, sessile or petiolulate interstitial leaflets also occur along the leaf midrib, leaflet apices acute to acuminate, base oblique, often sub-cordate. *Petiole* 2-5 cm long. *Inflorescence* lateral, a racemose cyme sometimes forked, of few to many flowers. *Pedicel* articulate in the upper half. *Calyx* deeply divided, the lobes c. 1 cm long narrow lanceolate. *Corolla* 2-2.5 cm diam., stellate, lobes narrow triangular, often reflexed, often 6-9 partite in cultivars, yellow. *Filaments* sparsely pubescent on the margin. *Anthers* 8-10 mm long including the sterile apex 2-3 mm long, lanceolate, cohering in a cone, pubescent within and united by marginal hairs, introrsely dehiscent by slits. *Ovary* glabrous or pubescent. *Style* erect; *stigma* terminal, included. Fruit a succulent *berry*, usually red, globular or depressed globular 1-2 cm diam. in naturalised forms, 5-10 cm diam. smooth or furrowed in cultivars. *Seeds* numerous, 2-3 mm long, compressed, pilose (with ruptured cell walls) drab buff-grey.

Distribution

Warm temperate areas of eastern Australia and sometimes near picnic grounds and campsites.

Notes

Not all authors retain *Lycopersicon* as a separate genus, McBride (1962, p. 158), Seithe (1962, p. 294), Heine (1976, p. 141). Neither of the monographers of the genus, Muller (1940) and Luckwill (1943), discuss the generic separation at any length. The only character separating *Lycopersicon* from *Solanum* is that the anthers open by slits into

the cone formed by the coherent anthers which have elongated sterile tips. "This character distinguishes the genus from *Solanum*" Muller (1940); "The basic character separating the genus from *Solanum*" Luckwill (1943). Most species of *Solanum* have each anther opening by apical pores, and the anthers may or may not form a cone. In all cases the flowers are pollinated by bees which buzz either the cone of anthers or each anther separately. The modification of the cone of anthers of *Lycopersicon* effectively provides a single apical orifice. It is questionable whether this difference in pollination detail is adequate to separate the species at generic level. Other characters such as pinnate-pinnatisect leaves, densely glandular pubescence, articulate pedicels, yellow flowers and hirsute seeds may be found in species of *Solanum*. Rick (1979, p. 667) argues persuasively for maintaining the genus and demonstrates that its reproductive links with related species of *Solanum* are slender. However if these criteria alone are used to define genera many large genera would be divided in small units of 10-12 species to create an enormous number of poorly separated taxa which would be a doubtful advantage.

However, if there is a utilitarian component in nomenclature, it is convenient to have this crop and its related species in a distinct genus rather than being lost in a welter of *Solanum* names.

The tomato is now a major crop and cultivated either under glass or in the open throughout the world. Hundreds of cultivars exist differing in maturity, leaf form, fruit size, colour and shape. Naturalised in warm temperate areas and often occasional about human habitation, picnic grounds etc., it is well known that seeds survive in human faeces and sewage. For a succinct account of the tomato see Rick (1978). The feral forms appear to revert rapidly to the small fruited wild type and where fruits are present on specimens they are usually 1-2 cm diam.; in addition the leaves are rarely as large as in cultivars.

The paucity of specimens in Australian herbaria is somewhat surprising. Perhaps as familiar and domestic plants they are not thought worthy of collection. Bailey (1906) reports the species as "abundant in all scrub clearings" (Queensland) but this is not reflected in herbarium specimens.

Specimens examined (all cited)

WESTERN AUSTRALIA: *Symon* 7127, 31.v.1971, King Edward River nr Kalumburu, naturalised in dense brush (ADW, PERTH).

QUEENSLAND: *Michael* 884, s.d., Mt Julian, nr Proserpine (BRI); *White* s.n., Jan. 1907, Kangaroo Point, nr Brisbane (BRI); *Domin* s.n., Dec. 1909, Harveys Creek, uncultivated (n.v., ?PR); *Kerr* s.n., 30.ix.1963, Millaa Millaa (BRI); *Swan* 74, 14.vii.1974, Mt Dryander, nr Proserpine (ADW, BRI); *Sharp & Durrington* 907, 17.xi.1973, Bird Island, 1 km W of Dunwich on Stradbroke Island (BRI); *Byrnes* 3849, 13.iv.1978, Brandy Creek, Conway Range (BRI); *Stanley & Ross* 78166, 15.xi.1978, Rosedale (BRI); *Stanley & Ross* 78228, 17.xi.1978, 20 km from Sarina on St Lawrence road (BRI).

NEW SOUTH WALES: *Camfield* s.n., 1.iv.1903, Gdns Govt Dom. (NSW); *Green* s.n., Feb. 1910, Randwick (NSW); *Knox Grammar School* s.n., 1.ix.1950, Beresford (NSW); *Johnson* s.n., 9.v.1951, Broughton Pass Cataract R. (NSW).

SOUTH AUSTRALIA: *Symon* 11274, 3.x.1978, Beresford Tank (SW of Lake Eyre), a fresh water dam (ADW).

7. NIEREMBERGIA Ruiz & Pavon

Ruiz & Pavon, Fl. Peruv. et Chil. Prodr. (1794) 23.

Herbs, sometimes rhizomatous, some woody below. *Leaves* mostly simple, narrow, glabrous or pubescent. *Flowers* solitary, terminal or in short sympodia, pedicellate or subsessile. *Corolla* tube slender, elongate, limb expanded, campanulate or infundibuliform. *Stamens* 5, 4 didynamous, 1 shorter, inserted at the summit of the tube, surrounding the filiform style. *Stigma* expanded. *Fruit* a septicidal capsule, the valves deeply bifid at dehiscence. *Seeds* prismatic, reticulate-foveate.

A genus of about 30 species most of which occur in Argentina and adjacent countries with one disjunct species in North America. One species is widely grown as a garden plant and possibly naturalised in New South Wales.

1. *N. hippomanica* Miers, London J. Bot. 5 (1846) 168.

Type Citation: "Provincias Argentinas, vernacule chu chu. v.v." Miers then cites two entities a) "In Prov. Cordovae et San Ludov.", and b) "Achias".

Type material: Not seen.

Herbaceous *perennial* with a subwoody rootstock from which numerous slender branches arise to 45 cm tall. Pubescent with minute simple hairs. *Leaves* linear about 20 x 1-1.5 mm. *Inflorescence* of terminal pedicellate flowers or from the upper leaf axils. *Pedice*l c. 5 mm long. *Calyx* tube 5-6 mm long, obconic, the veins conspicuous, lobes 5-6 mm long, narrow triangular. *Corolla* tube 10 x 1 mm, abruptly expanded into the rotate to broadly stellate limb 1.5-2.5 cm diam., lobes rounded and divided $\frac{1}{4}$ the length of the limb, intense violet, close to RHS Bishops Violet 37/2 with a yellow eye. *Filaments* c. 6 mm long, inserted at summit of the tube, erect, long exerted and enclosing the style, sparsely glandular pubescent, 4 didynamous in two pairs, the fifth lower, the *anthers* closely surrounding the stigma. *Ovary* ovate, ovules numerous. *Style* slender, expanded to the lunate-laminar stigma. *Capsule* ellipsoid 3-4 mm long, smooth, dehiscent, enclosed within calyx tube. *Seeds* c. 1 mm long, dark brown to black, prismatic, reticulate-foveate.

Notes

Millan (1941) in his revision of the genus maintains twelve varieties of *N. hippomanica*. Our material appears close to *N. hippomanica* var. *caerulea* (Miers) Millan which is based on *N. caerulea* Miers, London J. Bot. 5 (1846) (Type Citation: "Punta del Sauce, Prov. Cordovae. v.s. in herb. Hooker." (Gillies MSS. *N. caerulea*). Type Material: not seen). The name *N. hippomanica* var. *violacea* Millan has been used on two earlier collections from New South Wales.

The species is considered toxic to horses in Argentina, Miers (1846) above. The collection from Delungra was associated with the death of turkey poult.

Specimens examined (all cited)

NEW SOUTH WALES: Lloyd s.n., Nov. 1965, Delungra, "growing in backyard, suspected of poisoning poultry" (NSW); Blaxell 691, 16.xi.1971, Mt Arthur Lookout, 3 km W of Wellington, "herb ?naturalised, only plant seen" (NSW); Rodd 3012, 19.i.1976, Sydney Botanic Garden, "spontaneous in weedy waste-ground" (NSW).

9. PETUNIA Juss.

Juss., Ann. Mus. Paris 2 (1803) 215.

Herbs, stems often sprawling. Viscid-pubescent with glandular hairs. *Leaves* alternate or upper ones in pairs, entire, sessile or petiolate in young plants and later leaves sessile. *Inflorescence* axillary of a single pedicellate flower. *Calyx* campanulate, deeply lobed. *Corolla* funnellform or salverform, regular or slightly zygomorphic, shallowly or bluntly 5-lobed, white, pink, purple sometimes conspicuously veined or parti-coloured in cultivars. *Stamens* 5, inserted on the tube, 4 didynamous, the fifth shorter, *anthers* dehiscing by slits. *Ovary* bilocular, with a lobed hypogynous disc below, ovules numerous. *Style* slender, *stigma* dilated-capitate. *Fruit* a capsule, septicidal. *Seeds* numerous, globular, angled or prismatic, embryo curved or straight.

A genus of about 30-40 species mostly in South America with 1 species reaching North America. The genus is closely related to *Nicotiana* and differs principally in its solitary flowers and base chromosome number $n=14$ (*Nicotiana* $n=12$). The standard monograph remains Fries (1911).

Key to *Petunia* species

1. Leaves 1-1.5 cm long, linear-spathulate, corolla <1 cm long 3. *P. parviflora*
 Leaves 2-7 cm long, ovate to elliptic, corolla mostly >3 cm long 2
2. Corolla tube obconic, scarcely inflated, stamens inserted about the middle of the tube,
 corolla mostly white 1. *P. axillaris*
 Corolla tube somewhat inflated, stamens inserted below the middle of the tube, corolla
 often coloured 2. *P. × hybrida*

1. *P. axillaris* (Lam.) Britton, Sterns & Poggenburg, Prelim. Cat. (1888) 38.

Nicotiana axillaris Lam., Tabl. Encycl. 2 (1794) 7. *Basionym*.

Type Citation: "E Monte-Video, Commers. Caps. 2-locularis."

Type Material: Not seen, possibly at P.

Nicotiana obtusisepala Domin, Bibl. Bot. 89 (1929) 1147, plate 36, fig. 1.

Type Citation: Queensland; Hughenden (*Domin 11*, 1910).

Type Material: Not seen, PR, photo ADW!

The description is strongly suggestive of a *Petunia* and Goodspeed (1954) suggested that it represents *P. axillaris*. In his notes Domin considers the new species strongly remote from Australian species (of *Nicotiana*) yet scarcely introduced. I tentatively place it as a synonym of *P. axillaris* rather than *P. × hybrida* because of the relatively long scarcely inflated corolla tube.

Annual or short lived *perennial*, stems erect or decumbent. Viscid pubescent with erect glandular hairs of varied lengths, aromatic. *Leaves* 3-7 x 1.5-4 cm, ovate to elliptic, apex acute, base cuneate, lower leaves alternate, shortly petiolate, *petiole* to 2 cm long, winged, upper leaves sessile or subsessile, sometimes opposite, the upper leaves often increasingly reduced on mature flowering stems. *Inflorescence* of solitary, pedicellate, axillary flowers. *Pedicel* 2-4 cm long. *Calyx* c. 1.5 cm long, deeply lobed, lobes oblong, green, subfoliaceous. *Corolla* tube 3-4 cm long, obconic, scarcely inflated below the expanded limb, limb 4-6 cm diam., rotate or broadly stellate, slightly zygomorphic, limb divided about $\frac{1}{5}$ into rounded lobes, apex acute or rounded, white with pale greenish veining and dark veins in throat, sweetly scented. *Stamens* 5, 4 didynamous, the fifth shorter. *Filaments* 10-15 mm long, inserted about the middle of tube, the two longer ones terminating just below the stigma, second pair shorter, the fifth shorter and uppermost, geniculate at point of attachment, glabrous. *Anthers* 2-3 mm long, versatile, pollen yellow. *Ovary* c. 3-4 mm long, bluntly conical, bilocular, the base shortly enclosed in 2-lobed nectariferous disc, ovules numerous. *Style* 2-3 cm long, erect glabrous, *stigma* capitate, expanded, green. *Petiole* to 6 cm long in fruit, erect, *capsule* about 1 cm long, bluntly conical, glabrous. *Seeds* about 0.6 mm diam. globular or sub-angular, reticulate-foveate, numerous.

Distribution

Occasional in south-eastern Queensland and sporadic in eastern New South Wales.

Note

P. axillaris is one of the larger flowered species and has been grown as an ornamental. With *P. integrifolia* and complex hybrids between them it has contributed to the domesticated garden petunia which was given the name *P. × hybrida*. *P. axillaris* is distinguished by its relatively long, straight-sided, obconic tube with the stamens inserted about half way up. Other species either have an inflated tube and/or stamen insertion much lower down. Whether the material naturalised in Queensland and New South Wales was derived from introductions of the species or from reversions of the garden petunia is not clear. Smith & Downs (1966) consider *P. nyctaginiflora* Juss. to be a synonym of *P. axillaris*.

Specimens examined (all cited)

QUEENSLAND: *Sharpe & Lebler* 2476, 9.i.1979, Moreton district, Helidon, on a roadside leading to Ziegler's quarry (BRI); specimens cultivated from this at ADW, BRI, CANB, K, MO, NSW); *Jessup* 198, 19.vi.1975, Moreton district, Worlds End Pocket, approx. 10 km N of Ipswich (BRI; specimens cultivated from this collection at ADW, BRI, CANB, K); *Sharpe* 2520, 20.i.1979, Moreton district, 3 km N of Coolum beach (BRI; specimens cultivated from this to ADW, BRI, CANB, K, MO, NSW).

NEW SOUTH WALES: *Boorman s.n.*, Sept. 1907, Bingara, evidently naturalised, found many miles from any habitation and is well distributed over a large area of country between Bingara and Warialda (NSW); *Burgess s.n.*, Nov. 1910, East Maitland (NSW); *Constable* 6212, 12.x.1965, Nepean River, Douglas Park, 9 km E of Picton, only few plants seen in area (NSW); *Jacobs* 3377, 9.xi.1978, Tenterfield Road, 30 km SE of Bonshaw, along roadside (NSW).

2. ***P. X hybrida*** Vilm., Fl. Pl. Terre 1 (1865) 615.

Type Citation: Citation and specimens not seen.

Common Name: garden petunia.

Annual or short lived *perennial* herb, stems usually decumbent. Viscid-pubescent with glandular hairs of differing lengths, aromatic. *Leaves* 3-6 x 1.5-4 cm, ovate to elliptic, apex acute or rounded, base cuneate. Lower leaves petiolate alternate, *petiole* often winged, upper leaves sub-opposite sessile, increasingly reduced in mature flowering stems. *Inflorescence* of solitary axillary flowers. *Pedicel* 2-4 cm long. *Calyx* c. 1.5 cm long, deeply lobed, lobes oblong or often in cultivars sub-foliaceous and green. *Corolla* tube 3-4 cm long, obconic, slightly inflated below the expanded limb, limb rotate or broadly stellate 4-10 cm diam., slightly zygomorphic, the lobes rarely cut more than 1/2 way, lobe apex acute or rounded, entire or undulate, single or double, frilled, veined, self or parti-coloured, dull yellow, white, rose, reddish or rich purple in the many cultivars available, sweetly scented. *Stamens* 5, 4 didynamous the upper one shorter. *Filaments* 15-18 mm long, attached to the lower half of tube, geniculate at point of attachment, glabrous. *Anthers* 2-3 mm long before dehiscence, versatile, pollen white, yellow or bluish. *Ovary* c. 3 mm long, bluntly conical, the base shortly enclosed by a lobed nectariferous disc, bilocular, ovules numerous. *Style* c. 2.5-3 cm long, slender, erect, *stigma* capitate, expanded. *Capsule* 1-1.5 cm long, ellipsoid, glabrous. *Seeds* c. 0.6 mm long, sub-globose or angled, reticulate-foveate, numerous.

Note

Several species, *P. axillaris* (syn. *P. nyctaginiflora*) and *P. integrifolia* (syn. *P. inflata*, *P. violacea*), and complex hybrids between them have contributed to the garden petunia (Natarella and Sink, 1974). Numerous cultivars are available and they are very widely grown as ornamentals.

Selected specimen

NEW SOUTH WALES: *Rodway s.n.*, Nov. 1923, Yalwal, 15 miles SW of Nowra, old mine bldgs (NSW).

3. ***P. parviflora*** Juss., Ann. Mus. Paris 2 (1803) 216, t. 47, fig. 1.

Type Citation: No type material was cited but the description was based on plants from La Plata in the Commerson herbarium and therefore it may be at P.

Prostrate or decumbent herb 15-20 cm long, *annual* or possibly *perennial* as the lower stems have abundant adventitious roots. Pubescent with abundant minute glandular hairs. *Leaves* 5-12 mm long, oblong-linear to spathulate, entire, sessile. *Inflorescence* of solitary axillary flowers. *Pedicel* 1-2 mm long. *Calyx* 5-6 mm long, the lobes linear-spathulate, intersepalal membranes distinct. *Corolla* 5-9 mm long, funnel shaped, shallowly lobed, slightly exceeding the calyx lobes; *filaments* 3-4 mm long, attached near the base of the tube, 4-didynamous, the fifth shorter; *anthers* 0.5 mm long; style 3-4 mm, bent at tip. *Capsule* 3-5 mm long, two lipped, much exceeded by the spathulate calyx

lobes. *Seeds* 0.5 mm diam. subglobular, numerous, light brown, reticulate-foveate.

Specimens examined (all cited)

NEW SOUTH WALES: *Burges s.n.*, Nov. 1910, Stockton Beach, East Maitland (NSW); *Oakman s.n.*, 17.i.1941, Newcastle district (NSW); *Oakman s.n.*, 28.i.1941, Nobby's Head, Newcastle, military camp (NSW); *O'Reilly*, April 1948, Boggabri district (NSW).

8. PHYSALIS L.

L., Sp. Pl. (1753) 182; Gen. Pl. (1754) 85.

Plants *annual* or rhizomatous herbaceous *perennial* to subwoody short lived shrubs. Glabrous or pubescent with simple, forked, stellate or glandular hairs. *Leaves* linear to broad ovate, alternate, often geminate, petiolate. *Flowers* solitary, pedicellate, in leaf axils or stem forks. *Corolla* campanulate to rotate with an expanded limb, mostly yellowish, often with darker spots towards the base. *Stamens* 5; filaments attached near the base of the corolla tube; anthers oblong, opening by slits, yellow or bluish. *Ovary* bicarpellate, ovules numerous on enlarged placenta; style simple, erect. *Fruit* a berry enclosed in the enlarged calyx tube. *Seeds* lenticular, numerous.

A large genus of probably more than one hundred species well represented in North and South America with a few species recorded from temperate and tropical Asia. Several species are cultivated for their fruit and are now adventive, while several others are weedy in tropical and warm temperate areas. Despite the extensive accounts by Waterfall (1958, 1967) the species are still often difficult to identify especially as his monograph does not specifically include Europe, Asia or Africa. Menzel (1951) provides information on the cytotaxonomy and genetics of *Physalis*.

Many nomenclatural problems will remain almost insoluble until the names and taxa in Africa and Asia are studied and compared with American taxa. There is little doubt that cultivated and sub-weedy species of American origin were distributed at an early date and there are many superfluous names in existence.

Key to *Physalis* species

1. Herbaceous perennials with rhizomatous rootstock, tomentum of simple or forked hairs 2
 Annuals or softwooded subshrub sparsely or densely pubescent with simple or glandular hairs, never forked 4
2. Corolla drab white, the limb distinctly 5-lobed, fruiting calyx orange or red (cultivated) 1. *P. alkekengi*
 Corolla yellowish, the limb more or less entire, fruiting calyx greenish, yellowish or ochraceous 3
3. Tomentum of minute forked hairs, rarely simple (lens needed) leaves toothed or sinuate, ovate-lanceolate 9. *P. viscosa*
 Tomentum of simple hairs, leaves often with few weakly developed lobes, elliptic 8. *P. virginiana*
4. Obviously pubescent, hirsute or pilose with erect, simple or glandular hairs, corolla conspicuously spotted 5
 Sparsely pubescent or glabrescent, corolla blotches brownish or dull 6
5. Annual, anthers 2 mm, seeds 1.5 mm, calyx prominently 5-angled 7. *P. pubescens*
 Softwooded subshrub, anthers to 4.5 mm, seeds 1.75-2 mm, calyx more or less 10-angled, "Cape gooseberry" 5. *P. peruviana*
6. Anthers 3-4 mm, twisted after anthesis, flowers bright yellow, mostly >2 cm diam., berry mostly >1.5 cm diam., "tomatillo" 6. *P. philadelphica*
 Anthers <3 mm long, straight, flowers rarely >1.5 cm diam., berry <1.5 cm diam. 7
7. Leaves narrow elliptic, flower pedicels very slender 2.5-3 cm long, flowers whitish yellow 3. *P. lanceifolia*
 Leaves ovate-lanceolate, pedicels usually <2.5 cm long, flowers yellow or creamy yellow 8
8. Pedicels rarely >1 cm, corolla yellow, style 2-2.5 mm, stigma capitate, expanded, fruiting calyx circular in section, the angles not evident 2. *P. ixocarpa*
 Pedicels mostly >1 cm, corolla creamy yellow, style to 5 mm long slender, fruiting calyx with 5 main and 5 minor angles, reticulate veining conspicuous 4. *P. minima*

1. **P. alkekengi** L., Sp. Pl. (1753) 183.*Type Citation*: "Habitat in Italia".*Type Material*: Herb. LINN not seen. Microfiche AD!*Common Name*: Chinese lantern.

Herbaceous *perennial*, 50 cm tall, rarely branched, sparsely pubescent with long simple hairs. *Leaves* to 8 x 5 cm, commonly about 6 x 4 cm, geminate and appearing opposite, ovate, sometimes with a few weakly developed lobes or teeth, apex acute, base broadly cuneate to rounded; *petiole* 1-2.5 cm long, grooved above. *Inflorescence* a solitary pedicellate flower from the leaf axil. *Pedicel* 1-1.5 cm long. *Calyx* c. 1 cm long, divided about half way into acutely triangular lobes, densely pubescent. *Corolla* 13-17 mm long, the lobes 3-4 mm long, broadly triangular, drab white or pale yellow, spots not evident (dried material), pubescent towards the base. *Filaments* c. 4 mm long, glabrous. *Anthers* 4 mm long. *Ovary* 3 mm long, bluntly conical. *Style* 8-9 mm long, erect, glabrous. *Stigma* capitate, style and stigma projecting well beyond the anthers. Fruiting pedicels pendulous, the calyx to 5 x 4 cm, showy, orange-red, *berry* about 1.5 cm diam. reported red to orange but not seen.

Note

P. alkekengi is occasionally grown as a garden novelty. Willis (1972, p. 548) records it as sporadic in his areas J and N (Ballarat-Melbourne) but I have seen no specimens from there. It is readily distinguished by its distinctly 5-lobed corolla and colourful mature calyx.

Specimens examined

NEW SOUTH WALES: *Briggs s.n.*, 15.iii.1933, Broken Hill garden (ADW).

SOUTH AUSTRALIA: *Nagy s.n.*, 28.iv.1973, Norwood, garden grown (AD, ADW, CANB).

2. **P. ixocarpa** Brot. ex Hornem., Suppl. Bot. Hafn. (1819) 26.

Type Citation: "Hab.—T. intr. 1815—Est *Phys. angulata* horti hafn. sed sine dubio spec. distincta".

Type Material: At C. Not seen, for photo and discussion see Fernandes (1970).

Common Name: ground cherry.

An *annual* to 50 cm tall. Sparsely pubescent with minute simple hairs, on the stems mainly confined to a groove on the upper side, becoming glabrous. *Leaves* to 10 x 4.5 cm, commonly about 6 x 3 cm, ovate-lanceolate, irregularly toothed and lobed, apex acute to acuminate, base cuneate, oblique, strongly malodorous. *Petiole* to 6 cm, commonly 2-3 cm long. *Flowers* solitary in the leaf axil. *Pedicel* c. 1 cm long. *Calyx* 5 mm long, divided into triangular lobes 1.5-2 mm long. *Corolla* 10-12 mm diam. when flattened out, pentagonal to broadly stellate, pale yellow, with five dull brownish blotches, tufts of pale hairs below the blotches, swollen into shallow pouches below the hairs each with an inconspicuous nectary. *Filaments* 2.5-3 mm long, glabrous, lavender, loosely erect, a tuft of dendritic hairs between the filament bases and surrounding the nectary. *Anthers* 1-1.5 mm long, with a dark margin. Pollen white. *Ovary* bluntly conical, disc pale green, inconspicuous. *Style* 2-2.5 mm long. *Stigma* 1 mm diam. capitate, green, conspicuous, below the level of the anthers. *Fruiting calyx* c. 2 cm diam. 2.2-2.5 cm long, circular in section, ribs scarcely evident, the main body of the calyx almost globular, not highly shouldered, with slight purple veining, mature calyx pale green. *Berry* 11-14 mm diam., globular, green, (close to Scheeles Green RHS 860), slightly sticky. *Seeds* c. 2 mm diam., lenticular. *Cotyledons* 9-10 mm long, ovate-lanceolate, apex acute, hypocotyl c. 2 cm long.

Distribution

See Map 6.

Notes

The name *P. ixocarpa* refers to the sticky berry but each of the six species of *Physalis* I have grown has had a berry somewhat sticky and I do not consider stickiness to be a very useful diagnostic character.

A critical account of the history and identity of *P. ixocarpa* is given by Fernandes (1970). In Australia it has commonly been called *P. angulata* or confused with *P. minima*. The name has also been used widely for the plant now known as *P. philadelphica*, the domesticated "tomatillo".

I have referred the collection *C. T. White 12583*, 9.i.1944, Tummalville, to this species. Progeny from this collection were studied by Menzel, *Proc. Amer. Philos. Soc.* 95 (1951) 132-183, she refers to it at length (her No. 493b.) 135, 157-161, and gives the chromosome number as $2n=24$ (diploid), karyology in fig. p. 139. The collection yielded a vigorous hybrid with *P. angulata*. Of interest is her equation of the Australian collection with two from Portugal, as the more recent paper by Fernandes shows that the Portuguese plants are *P. ixocarpa* sensu strictum non auct. plur. (= *P. philadelphica* Lam.). Menzel did not consider her collection to agree with her concept of *P. ixocarpa* (= *P. philadelphica*). She did consider it to be closest to some species in the *Angulatae* group of species ie. *P. lagascae*, *P. angulata*, *P. ixocarpa*, *P. lanceifolia*. The only cross that provided germinable seeds was that with *P. angulata*, and the hybrid was large, vigorous and sterile; no seeds were obtained in over 1000 fruits. The hybrid plants were triploid. Unfortunately no crosses with the Portuguese plants seem to have been made. "The identity and origin of *P. sp.* 493b remains questionable However it is worthy of note that of all crosses tried with *P. ixocarpa* (= *P. philadelphica*) 493b was the only one which yielded seeds approaching maturity It may be regarded as a connecting link between *P. ixocarpa* and *P. angulata*, distinct from both, but, from karyological and breeding evidence, probably more closely related to the latter".

Although the first record in Australia is a collection sent in by the Agricultural Bureau from Miranda, N.S.W. in 1925, the species was not collected again until it spread widely in both Queensland and New South Wales in the mid to late 1940's suggestive of a wartime introduction. It definitely appears to be more weedy and aggressive than *P. minima* and where label details are available it is described as "weed of fallows; cultivated areas; on cultivated land; in summer cultivated crops of the north coast; recent introduction on open pasture; natural pasture cultivated two years ago".

Specimens examined (all but 2 cited)

QUEENSLAND: *White 12583*, 9.i.1944, Tummalville (BRI); *White 12803*, 3.vi.1946, between Toowoomba & Warwick (BRI); *Pointon s.n.*, 18.xii.1948, Kingaroy (BRI); *Smith s.n.*, 8.ii.1949, Warwick, Darling Downs (BRI); *van Rosendal s.n.*, 19.vi.1963, Elliott River bank S of Bundaberg (BRI); *Little s.n.*, 31.i.1964, Swan Creek 1 mile E of Hermitage (BRI); *Knowles & Lebler s.n.*, 25.xi.1964, Cannon Hill (BRI); *Beckman s.n.*, 6.i.1965, 4 miles from Kenmore Junction along Moggill Rd, nr Mt Crosby road junction (BRI); *Alcorn s.n.*, 15.v.1967, Burnside via Nambour (BRI); *Durrington 476*, Jan. 1973, Serpentine Creek, 11 km NE of Brisbane (BRI); *Cent s.n.*, 6.iii.1973, Indooroopilly (BRI).

NEW SOUTH WALES: *Agric. Bur. s.n.*, Apl 1925, Miranda (NSW); *Couch s.n.*, 24.iii.1948, Yellow Rock, Albion Park (NSW); *Cutler s.n.*, Jan. 1949, Oakwood via Inverell (NSW); *Baird s.n.*, Mch 1950, Dubbo (NSW); *Noy s.n.*, Jan. 1951, Bellata (NSW); *Johnson s.n.*, Apl 1951, Inverell (NSW); *Vane s.n.*, Mch 1956, Kyogle (NSW); *Bootes s.n.*, 4.iv.1956, nr Llangothlin (NSW); *Montgomery s.n.*, 24.iii.1958, Ashley (NSW); *Green s.n.*, 2.vi.1961, Richmond (NSW); *Burgess s.n.*, 10.iv.1970, Mt Irvine (BRI); *McBarrow 20181*, 18.v.1971, Vet. Res. Stn, Glenfield (NSW); *Ryan s.n.*, 14.iii.1973, Scone (NSW); *Townsend s.n.*, 17.iv.1973, Alectown (NSW); *Martin s.n.*, 31.i.1974, Kilgra (NSW); *Pritchard s.n.*, 11.vi.1976, 'Mocort', Moree (NSW).

3. *P. lanceifolia* Nees, Linnaea 6 (1831) 473.

Type Citation: "Habitat in Peruvia (Ruiz et Pavon); in Mexico (Herb. Hort. Reg. Ber.)—In Amer. bor. ?(Michx.) Vidi siccam in Herb. Hort. Reg. Ber."

Type Material: Not seen.

Annual to 50 cm tall, sparsely pubescent on young growth with minute, appressed, antrorse, simple hairs, glabrescent. *Leaves* to 12 x 3 cm, more commonly about 5-7 x 2 cm, narrow elliptic, entire, sinuate or with several forward pointing lobes, lobes 1-4 mm long, apex rounded or acute, sinus rounded, leaf apex acuminate, base long cuneate. *Petiole* to 4 cm long, commonly c. 1.5-2 cm long, grooved above. *Inflorescence* a solitary flower from leaf axils and stem forks. *Pedicel* 2-3 cm long, slender. *Calyx* 4-5 mm long, divided about $\frac{1}{3}$ of the way into triangular lobes. *Corolla* c. 1 cm diam. pentagonal, almost white at the margin suffused deeper yellow towards the base, the blotches deeper yellow and poorly defined, corolla tube swollen into shallow pouches between the filaments, pubescent below the blotches and between the filaments with sparsely dendritic pale hairs. *Filaments* 2-4 mm long, slender, glabrous. *Anthers* 1.5-2 mm long white or very pale blue, pollen white. *Ovary* 1.5 mm long, almost globular, disc pale orange-yellow. *Style* 2.5-3 mm long slightly expanded upwards. *Stigma* capitate, green, slightly expanded. *Fruiting pedicel* 2.5-4.5 cm long, calyx 2-3 cm long 2-2.5 cm wide, 10-angled, veins purplish. *Berry* (7-) 11.6 (-15) mm diam. olive-green suffused purple when mature, sticky. *Seeds* 1.75-2 mm long, lenticular, a mean of 85 in six fruits counted.

Distribution

See Map 5.

Notes

This species is confined to seasonally wet areas with heavy clay soils. Collectors describe "grey cracking clay; brown clay loams; drying mud; solonized brown clay; grey self mulching soil and dry clay beds".

The species is distinguished from other species of *Physalis* by its relatively long slender pedicel, small corolla and shallowly lobed elliptic leaves. It is apparently a relatively recent arrival in Australia, the first collections coming from Dalby, Qld in 1924. The species is native to southern United States and to Mexico.

Specimens examined (all cited)

QUEENSLAND: *McCarthy s.n.*, Apl 1924, Dalby (BRI); *Guard s.n.*, Apl 1947, 30.v.1947, Dalby (BRI); *Pedley 380*, 15.i.1959, Hannaford (BRI, CANB, K); *Johnson 2245*, 27.iv.1961, Reedsdale, 5 miles NW of Brymount (BRI, K); *Alcorn s.n.*, 25.v.1964, cult. Brisbane, seed from Brookstead (BRI); *Smith s.n.*, Feb. 1972, "Aberdeen", Wyaga, 65 km SW of Millmerran (BRI); *Wilson 1833*, 28.iii.1978, 36 km NE of Hebel on Dirranbandi road (NSW); *Duggan s.n.*, 14.ii.1979, Tiara Shire, corner Bruce Highway and Neerdie Road (BRI).

NEW SOUTH WALES: *Everist 540*, 8.xii.1969, 21 km E of Walgett on Pilliga Rd (BRI); *Pritchard s.n.*, 11.vi.1976, "Glennie", Moree (NSW); *Wilson 1798*, 28.iii.1978, Narran Road on Goodooga-Lightning Ridge Road (BRI, NSW); *Wilson 2007*, 25.xii.1978, "Iolanthe", 26 km SW of Garah (BRI, NSW).

VICTORIA: *McBarrow 5516*, 21.iii.1951, Wodonga (NSW).

4. *P. minima* L., Sp. Pl. (1753) 183.

Type Citation: "Habitat in Indiae aridis sordidis".

Type Material: Not seen. Heine (1976, p. 129) cites a lectotype in Herb. Hermann (BM, photo. ADW!). For discussion of typification see Heine, l.c., and note below.

P. parviflora R.Br., Prodr. (1810) 447.

Type Citation: "(T.) v.v.", i.e. Litus intra Tropicum, the coast of Queensland and Northern Territory westward to Arnhem Bay.

Type Specimen: Not seen (probably at BM).

Common Name: wild gooseberry.

A bushy *annual* rarely to 50 cm long. Pubescent on young tips, calyces, with minute (lens needed) simple, antrorse hairs, becoming glabrous. *Leaves* to 10 x 6 cm, more often 4-6 x 2-3 cm, ovate-lanceolate, entire or with up to c. 7 teeth (to 5 mm long) or shallow angular lobes on each side, apex acute to acuminate, base rounded to cuneate, often oblique. Petiole to 6 cm long, more often c. 1-3 cm. Flowers solitary from leaf axil. *Pedicel* 2-2.5 cm long at anthesis. *Calyx* c. 5 mm long, divided about half way into acutely triangular lobes, minutely pubescent. *Corolla* 7-8 mm long, c. 15-16 mm diam. pentagonal, pale creamy yellow with five relatively large brownish spots, diffuse on their outer margin and cut off below by a ring of hairs, centre of corolla appearing slightly greenish yellow, corolla tube slightly swollen into shallow pouches each containing a nectary, corolla tube glabrous between the filament bases. *Filaments* 4-5 mm long, erect, glabrous, slightly speckled brown. *Anthers* 2-2.5 mm long, grey-blue or pale blue, pollen white. *Ovary* 1-1.5 mm long, bluntly conical, disc pale yellow-green. *Style* 4-5 mm long, erect, tinged green. Stigma green, just equal to the height of the anthers. *Berry* 8-14 mm diam. globular, enclosed in the inflated calyx 25-30 mm long, with five principal and five minor veins. *Seeds* 1.5 mm long, flattened, pale yellow, minutely reticulate, numerous. *Cotyledons* 8-9 x 5-6 mm, ovate, glabrous, hypocotyl 1-1.5 cm, minutely pubescent.

Distribution

See Map 6.

Notes

Waterfall (1967, pp. 221-222) considers *P. minima* L. a *nomen confusum* but Heine (1976) 130, considers it can be typified without ambiguity and proposes the lectotype "Solanum vesicarium zeylanicum baccis folliculis herbaceis" numbered 97 in the Hermann collection at the BM (photo ADW). The specimen is a leafy shoot with four fruits, flowers are not visible. Most of the Australian collections have leaves that are more lobed and have less rounded leaf bases than this specimen. As far as one can judge the fruits do not differ significantly. The Hermann specimen also matches six duplicates from MO determined as *P. angulata* L. (type Herb LINN 247.9 microfiche AD! "Habitat in India utraque"). I doubt that these two names represent different species but as far as I can trace they have not been formally treated as synonyms. Waterfall does not treat these two species as synonymous, but considers *P. minima* L. when treating *P. lagascae* Roem. & Schult., which Heine, l.c., considers a synonym of *P. minima*. The latter species has bluish or violet anthers and hairs 2-4 mm long, these hairs being totally absent from Australian material. However, he does include *P. lagascae* var. *glabrescens* Schulz, described as "less hairy, glabrate, the stems with few hairs or none". As Waterfall did not publish an account of *Physalis* in Eurasia we do not know his views on this problem.

P. minima is widespread across northern Australia and has been extensively collected. It also appears to extend to the tropics north of Australia. The collections suggest that it was a pre-1788 introduction. However like *Datura leichhardtii* and *Solanum erianthum* it is a discordant element in the Australian flora and, like them, may have resulted from the earliest European contacts between Central America and South East Asia. If so, there would have been nearly 250 years for spread, change and adaptation even before 'Species Plantarum' (1753) and 300 years before the earliest colonisation, but not necessarily earliest contacts with Australia. A rapidly expanding population is likely to be a more variable one and this could account for the variability of the South East Asian specimens and the present inability to match these precisely with any American taxa. *P. minima* has been confused with *P. ixocarpa* but does not appear to be so aggressively weedy as that species.

Selected specimens

WESTERN AUSTRALIA: (selected from 24 specimens examined): *Perry 3043*, 26.vii.1952, Kimberley Res. Stn (AD, BRI, CANB, K, MEL, NSW, NT); *Royce 6927*, 8.v.1962, Mt Anderston Stn, Fitzroy River (L, PERTH); *Symon 10255*, 31.v.1975, Mt House Stn (ADW, MO, PERTH); *Pullen 10725*, 15.iv.1977, 14 km S of Forest Creek, nr Ord Hill (CANB, PERTH, WIR).

NORTHERN TERRITORY (selected from 39 specimens examined): *Specht 175*, 4.iv.1948, Darwin, Nightcliff (AD, BRI, CANB, K, MEL, NSW); *Perry 2690*, 11.viii.1949, Victoria River NE of Auvergne Stn (AD, BRI, CANB, K, MEL, NSW, NT); *Wilson 376*, 7.iii.1965, Maude Creek, 19 km NE of Katherine (BRI, CANB, K, L, NSW, NT, US); *McKean B190*, 23.xii.1971, Humpty Doo Expt. Rice Farm (CANB, DNA, K, NT); *Latz 6064*, 2.vii.1975, Elcho Island (CANB, DNA, L, NT); *Must 1579*, 10.vii.1977, Victoria River crossing (CANB, CBG, DNA, NT).

QUEENSLAND (selected from 79 specimens examined): *Brown s.n.*, 1802-5, east coast (MEL); *Smith 3032*, 15.iv.1947, Kingarry (BRI, CANB); *McKee 9060*, 15.iv.1962, Mareeba (CANB, NSW); *Symon 4807*, 20.v.1967, 40 km S of Laura (ADW, BRI, CANB, US); *Symon 4844*, 22.v.1967, 19 km N of Musgrave Stn (ADW, BRI, K); *Byrnes 3642*, 6.iv.1978, Eungella Dam (BRI).

NEW SOUTH WALES (all cited): *Bauerlin s.n.*, Oct. 1892, Ballina (NSW); *Guilfoyle s.n.*, s.d., Tweed River (MEL); *Simmonds s.n.*, Apl 1897, Richmond River (BRI); *Cheel s.n.*, 31.v.1911, Penshurst (NSW); *Straatmans 323*, 19.vii.1959, 16 km N of Wauchope (CANB); *Salasoo s.n.*, 7.i.1971, Nymboida to Clouds Creek (NSW); *Coveny 6584 & Powell*, 10.vi.1975, Cockle Creek N of Booragul (ADW, BRI, CANB, NSW, [G, HUJ, KW, KYO, L, LE, MO, NBG, P, PRE, RSA, S, UC, W not seen]).

5. *P. peruviana* L., Sp. Pl. ed. 2, 2 (1763) 1670.

Type Citation: "Habitat Limae. Alstraemer ".

Type Material: Not seen (Microfiche Herb. LINN, AD!).

Common Name: Cape gooseberry

Soft wooded, short lived *shrub* to about 1 m tall, straggly with age, unarmed. All parts densely pubescent with tomentum of erect simple or glandular hairs to 1 mm long. *Leaves* in alternate pairs, one larger than the other, to 13 x 13 cm but mostly about 6 x 4 cm, ovate-acuminate, base cordate, margin entire or with few blunt angular lobes or the lobes developed, triangular, c. 0.5 cm long, apex acuminate; *petiole* to 5 cm long, commonly about 2-3 cm. *Inflorescence* a solitary pedicellate flower in the leaf axil. *Calyx* 1-1.5 cm long, densely pubescent, purplish, divided about half way into acuminate-triangular lobes. *Corolla* 1.5-2 cm diam. rotate to shallowly 10-lobed the inter-acuminal tissue exceeding the acumens, sparsely pubescent outside on the main veins, yellow with well defined purple-brown blotches towards the base, swollen into shallow nectary pouches between the filaments and densely pubescent with pale yellowish dendritic hairs below the blotches and around the nectaries. *Filaments* 3-5 mm long, purplish. *Anthers* 4-4.5 mm long, bluish, pollen pale. *Ovary* 2-2.5 mm diam. rounded, glabrous, disc pale orange-yellow. *Style* 5-7 mm long, erect, purplish. *Stigma* capitate, expanded. *Berry* 1.5-2 cm diam, globular, aromatic, pale ochre-yellow when ripe, totally enclosed in the inflated angular calyx tube c. 3-3.5 cm long, the veins often prominent, the calyx lobes free at the apex up to 1 cm, acuminate, the whole pale yellowish-green when ripe finally drying pale brown. *Seeds* 1.75-2 mm long, discoidal, light bright brown, minutely shallowly reticulate, 106 and 111 in two fruits counted. *Cotyledons* 7 x 4-5 mm, ovate, sparsely pubescent, hypocotyl c. 1 cm long, densely pubescent.

Distribution

See Map 4.

Notes

P. peruviana has been widely cultivated as a minor fruit crop in the warm temperate areas of the world (Legge, 1974). It has become naturalised in disturbed sites in warm temperate areas frequently in mesic conditions. The fruits are aromatic and palatable and if not eaten fresh can be cooked. The specimen cited by Bentham, N. Australia, Sturt

River, *F. Mueller* (MEL!) almost surely comes from the Sturt River a little south of Adelaide. There seem to be no recent collections from W. Australia.

Selected specimens

WESTERN AUSTRALIA: *Oldfield 501*, s.d., Cape Leschenault (MEL); *Oldfield 501*, s.d., estuary of the Murray swamps (MEL).

NORTHERN TERRITORY: *Schultz s.n.*, s.d., Pt Darwin (K).

QUEENSLAND (selected from 16 specimens examined): *Mueller s.n.*, s.d., Brisbane River (K, MEL); *White 7742*, 3.vi.1931, Upper Brookfield, nr Brisbane (BRI); *Shepherd 738*, 6.xi.1966, nr Imbil (CANB, NSW); *Dowling s.n.*, 18.x.1968, Indooroopilly (BRI); *Stocker 1509*, 16.viii.1976, Python logging area, Danbulla (BRI); *Stanley 7823*, 18.vii.1978, Long Pocket (BRI).

NEW SOUTH WALES (selected from 37 specimens examined): *Brown s.n.*, s.d., Pt Jackson (K); *Beckler s.n.*, s.d., Clarence River (K, MEL); *Evans 2557*, 22.xi.1966, Boyne Nat. Pk (A, CANB, K, L, MEL, NSW); *Coveny 6290*, 4.v.1975, Audley, Roy. Nat. Pk (BRI, NSW); *Powell 235*, 1.x.1975, 9 km NE of Bulahdelah (ADW, NSW).

LORD HOWE ISLAND: *Boorman s.n.*, May 1920, Lord Howe Island (NSW); *Johnson & Rodd 1228*, 9.ix.1970, Lagoon shore nr Hunter Bay (NSW); *Rodd 1750*, 23.iii.1971, gully behind North Beach (NSW); *Pickard 1480*, 17.v.1971, Summit Ridge of Mt Lidgbird (NSW); *Pickard 2828*, 12.xii.1975, S end of Little Slope (NSW).

VICTORIA (all cited): *Robbins s.n.*, 1937, Orbost above Betchely (MEL); *Willis s.n.*, 15.viii.1944, Kalimna Gully, Lakes Entrance (MEL); *Beaulehole 39101*, 1950, Moleside Creek, Lower Glenelg Nat. Pk (MEL); *Beaulehole 32965*, 30.xii.1969, Mullet Creek, Mallacoota Inlet (MEL); *Beaulehole 43943*, 7.i.1974, 6.5 km W of Apollo Bay (MEL).

TASMANIA: *Copley 4667*, 17.i.1975, Boat Harbour, Wynyard area (AD, BM).

SOUTH AUSTRALIA (all cited): *Mueller s.n.*, 1849, Sturt River (MEL); *Blandowski s.n.*, Sept. 1849, between Adelaide and Hahndorf (MEL); *Black s.n.*, 26.xii.1908, on a creek nr Yankalilla and Normanville (AD); *Cleland s.n.*, 20.i.1926, 10.xi.1950, Upper Hindmarsh River (AD); *Cleland s.n.*, 28.ii.1946, Mt Benson (AD); *Hilton 1501*, 20.vi.1955, Waterfall Gully Creek (ADW); *Eichler 14580*, 31.xii.1957, Waterfall Gully (AD); *Symon 2933*, 22.viii.1964, Waterfall Gully (ADW, K); *Swinbourne s.n.*, 28.vi.1969, Hindmarsh Falls (AD); *Symon 10560*, 27.i.1976, Hindmarsh Falls (ADW).

6. *P. philadelphica* Lam., Encycl. 2 (1786) 101.

Type Citation: "This Coqueret was cultivated in 1784 in the Kings Garden; we believe it originated from northern America".

Type Material: Herb, Lam. (P, not seen).

P. ixocarpa auct. pl., non Brot. ex Hornem.

Common Name: tomatillo.

Annual to 50 cm high, sparsely pubescent with erect, few-celled hairs and smaller appressed hairs mainly on the younger stems. *Leaves* to 12 x 8 cm more often c. 6 x 3 cm, ovate-lanceolate, apex acuminate, margin sparsely and irregularly toothed, base bluntly cuneate, oblique. *Petiole* (1.5-) 3-4 (-7) cm long, grooved above and pubescent in groove. Flowers solitary in leaf axil and in stem forks. *Pedicel* 3-13 mm long. *Calyx* tube c. 4 mm long, the lobes 4-5 mm long, broadly triangular, sparsely pubescent along main veins. *Corolla* 1.5 cm long, c. 2.5-3.0 cm diam. when flattened out, the limb both reflexed and pleated, rotate, margin entire except for inconspicuous acumens, close to Aureolin yellow, with five brownish spots in the throat which are terminated below by a ring of dendritic hairs which fill the space between the corolla and the filaments, and extend down and surround the nectaries, corolla tube slightly swollen into small pouches below the spots each of which contain a nectary, glabrous outside. *Filaments* 4-5 mm long, sometimes slightly unequal, blue, glabrous. *Anthers* 3-4 mm long, with dark bluish margins, pollen white, top of anther twisted towards the stigma after anthesis. *Ovary* c. 1.5 mm diam. bluntly conical, green, glabrous. *Style* 8-9 mm long, erect, exceeding the anther tips, blue. *Stigma* green, scarcely expanded. Fruiting calyx (25-) 30 (-35) mm diam., (22-) 31 (-36) mm long, the 10 angles not prominent, almost circular in cross section, paling to yellowish green at maturity with or without purplish veins. *Berry* (17-)

24 (-30) mm diam., (16-) 22 (-28) mm long, dark green paling to whitish green flushed purple where exposed or under cold conditions, slightly sticky to touch, calyx well filled or completely filled by the berry. *Seeds* 2-3 mm diam., broadly reniform, (55-) 161 (-364) in fifteen berries counted. *Cotyledons* 7-8 x 13-15 mm, ovate-oval.

Distribution

Sparingly naturalised in south-eastern Queensland and north-eastern New South Wales.

Notes

P. philadelphica may be distinguished by its relatively large bright yellow flowers and more especially by the anthers characteristically twisted after dehiscence. The few specimens in Australian collections had previously been called *P. angulata* and *P. ixocarpa* and the species was probably introduced under the latter name. It is one of the species of *Physalis* that is occasionally cultivated as a novel edible berry but does not appear to be as attractive to eat as *P. peruviana*. This is probably the species referred to by Beadle, Evans & Carolin (1972, p. 486) as *P. angulata* L. A note on a specimen collected by C.T. White at Killarney in Nov. 1917, bears the note "makes excellent jam, better than Cape Gooseberry".

Heiser (1969, p. 109) describes it (as *P. ixocarpa*) as an old cultivated plant of Mexico and Guatemala and it was more frequently cooked than eaten raw.

Waterfall (1967, p. 214) describes two varieties and one form: forma *pilosa* with pedicel and calyx more or less pilose; var. *parviflora* with smaller flowers and anthers and var. *immaculata* with the corolla blotches being faint or absent. For a recent critical discussion of the nomenclature of this species see Fernandes (1970).

Specimens examined (all cited)

WESTERN AUSTRALIA: *Major & Son s.n.*, 10.ii.1961, Spearwood (PERTH).

QUEENSLAND: *White s.n.*, Nov. 1917, Killarney (BRI); *Ellis s.n.*, 1.x.1960, Brisbane (cult.) (BRI); *Henderson 360*, 22.ii.1968, Mt Wilson, E of Warwick (BRI); *Woodman s.n.*, June 1960, Peachester (BRI); *Pratten s.n.*, 30.v.1978, Mt Kilcoy (BRI).

NEW SOUTH WALES: *White 12558*, 15.iii.1944, Acacia plateau (BRI); *Everist & Webb 1389*, 23.xi.1946, Clarence River, nr Little Oakey Creek, Stanthorpe-Woodenberg Rd (BRI).

VICTORIA: *Reader s.n.*, 8.iv.1898, Warners garden, Coker Dam nr Dimboola (MEL); *Smith s.n.*, Mch 1944, cult. garden at Kew (MEL).

7. *P. pubescens* L. Sp. Pl. (1753) 183.

Type Citation: "Habitat in India utraque Θ".

Type Material: Not seen (Microfiche Herb. LINN, AD!).

Annual to 50 cm tall, pubescent with simple or glandular hairs, lower stem hirsute, pilose to hispid above. Lower *leaves* to 10 x 8 cm but mostly c. 6 x 4 cm, ovate to ovate-elliptic, margin with small teeth or blunt triangular lobes, apex acuminate, base cordate, oblique. *Petiole* to 7 cm long but commonly 1-3 cm. Flowers solitary from stem forks and leaf axils. *Pedicel* to 10 mm long. *Calyx* tube c. 2 mm long, lobes 3-4 mm long, triangular, pubescent. *Corolla* 7-11 mm long, 15 mm diam. pentagonal, yellow with five distinct purple-brown spots sharply demarcated and not confluent, tufts of hairs at the base of each spot, extending down to form a ring of sparse pubescence around each nectary, corolla tube slightly inflated below each spot into shallow pouches each containing a nectary, pubescent outside where exposed in the bud. *Filaments* 3-5 mm long, lavender-purple, slightly swollen upwards, contracted below the anther, sparsely pilose. *Anthers* c. 2 mm long, purple margined, pollen white. *Ovary* c. 2 mm long bluntly conical, glabrous, annular disc paler yellow-green. *Style* 4-5 mm long, erect, whiteish. *Stigma* green. Fruiting calyx enlarged, 3-4 cm long, prominently five-angled, pale yellowish green to light brown when mature. *Berry* 1.2-1.5 cm diam., yellowish green, globular to

ovoid, calyx and berry readily shed when ripe. *Seeds* 1.5 mm long, discoidal, light brown, an average of 191 in 10 fruits counted.

Distribution

Doubtfully naturalised in Western Australia.

Note

P. pubescens is native to northern and central America where it is widespread. It is now almost pan tropical in distribution. The few and irregular collections in Australia suggest that it is doubtfully naturalised. It is known to be cultivated as a virus test plant in some research centres.

Specimens examined (all cited)

WESTERN AUSTRALIA: *Gardner s.n.*, Aug.-Sept. 1938, Yatheroo in limestone caves (PERTH); *Price s.n.*, 20.ii.1959, Bowelling (PERTH).

NEW SOUTH WALES: *Cheel s.n.*, s.d., cultivated by H. Rumsey at Dunbar (NSW).

VICTORIA: *Warner's Garden s.n.*, 20.iii.1898, Coker Dam (nr Dimboola) (MEL).

8. *P. virginiana* Mill., Gard. Dict. ed. 8 (4) (1768).

Type Citation: None cited. "Winter cherry with an herbaceous stalk and oval spear shaped leaves which are acutely indented".

Type Material: Possibly at BM, not seen.

P. virginiana var. *sonorae* (Torr.) Waterfall, Rhodora 60 (1958) 154.

P. pumila Nutt. var. *sonorae* Torr., Botany of the Mexican Boundary (1859) 153. *Basionym*.

Type: Waterfall l.c. cites Geo. Thurber 418, Fronteras, Sonora, Mexico, June 1851, at NY with two isotypes at GH. Not seen by me.

Herbaceous *perennial* 30-50 cm high, with extensive rhizomatous root system. Sparsely pubescent on young-parts with minute, curved, appressed, antrorse simple hairs, glabrescent. *Leaves* to 9 x 3.5 cm but commonly c. 6 x 2 cm, elliptic, entire or with a few weakly developed lobes or teeth, apex acute to acuminate, base cuneate. *Petiole* 1.5-3 cm long, grooved above. *Inflorescence* of solitary flowers from leaf axils and stem forks. *Pedicels* c. 1 cm long. *Calyx* 10-12 mm long, divided about half way into acuminate triangular lobes. *Corolla* 10-12 mm long, rotate, the lobes scarcely evident, greenish-yellow (one report, not seen fresh), with darker spots at the base of each petal, pubescent below the spots and between the anthers. *Filaments* 3-4 mm long, somewhat thickened and swollen about the middle. *Anthers* 3.5-4 mm long, yellow, pollen white. *Ovary* c. 2.5 mm long, bluntly conical. *Style* 6-8 mm long, glabrous. *Stigma* somewhat expanded. Fruiting pedicel not much enlarged; calyx 1.5-2.5 cm long to 1-2 cm wide (herb. spec.) more or less 10-angled, *berry* c. 1 cm diam. colour not noted.

Distribution

See Map 5.

Notes

This species is primarily a weed of cultivation and several collections report that it forms large clonal patches. Only one collection, *Leys*, Nea, has details of soil type "black self mulching soil" and *Hyland*, Geurie, states "stock will not eat this weed". In contrast to most *Physalis* collections this species does not appear to fruit very freely and only one third of the collections seen bear any fruit. The fruits are relatively smaller than most other *Physalis* in Australia. It may be distinguished from *P. lanceifolia*, to which it bears some resemblance in foliage, by its rhizomatous root stock, shorter pedicel, longer calyx with longer narrower lobes, larger corolla, the inflated filaments and longer anthers;

from *P. philadelphica* by its rhizomatous habit, narrower leaves, longer calyx with narrower lobes, greenish-yellow corolla, inflated filaments, straight anthers and smaller calyx and berry. Willis (1972, p. 548) refers to this species in a note as *P. angulata* L.

Waterfall (1958, p. 142) describes seven varieties and one form and later (Waterfall, 1967, p. 118) adds a further two varieties. In north and central America it is obviously a widespread and variable species complex. The name *P. macrophysa* Ryd. (reduced by Waterfall to a form of *P. virginiana*) has been applied to some Australian collections, but as this form has calyces 4-5 cm long and 3-4 cm wide it obviously does not apply here.

Specimens examined (all cited)

QUEENSLAND: *Bailey s.n.*, ?1906, ?Gatton (BRI); *Liverseed s.n.*, Jan. 1919, Hermitage State Farm (BRI); *Compagnoni s.n.*, 3.i.1927, Wondai (BRI); *Shire Clerk s.n.*, Feb. 1937, Glengallan Shire, Warwick (BRI); *Beitchel s.n.*, Jan. 1947, Hermitage nr Warwick (BRI); *Pink 124*, Sept. 1947, Hermitage nr Warwick (BRI); *Lee s.n.*, 17.iv.1961, between Warwick and Freestone (BRI); *Gillam s.n.*, 28.i.1966, 1 mile from Brookstead (BRI, NSW); *Robinson s.n.*, 5.xii.1967, 6 miles NW of Wondai (BRI); *Porter s.n.*, 29.i.1971, 5 miles SW of Pittsworth (BRI).

NEW SOUTH WALES: *Anon s.n.*, Feb. 1928, Molong (NSW); *Shire Clerk s.n.*, Dec. 1935, Cudal (NSW); *Nicholson s.n.*, May 1936, Coonabarabran (NSW); *Nicholson s.n.*, 6.ii.1937, Coonabarabran (NSW); *Standing s.n.*, 5.i.1945, Tamworth (NSW); *Caldwell s.n.*, Feb. 1949, Manilla (NSW); *Ross s.n.*, 7.i.1952, Wellington (NSW); *Weeds Inspector s.n.*, Feb. 1954, Mandowah Shire, Manilla dist. (NSW); *Lisle s.n.*, 5.iii.1957, Quirindi dist. (NSW); *McNamara s.n.*, Jan. 1962, Quirindi (NSW); *Hyland s.n.*, Dec. 1968, "Glenore", Geurie (NSW); *Leys s.n.*, 27.xii.1977, Nea, nr Gunnedah (NSW).

VICTORIA: *Pye s.n.*, 1907, Dookie (MEL); *Pye s.n.*, Jan. 1909, Dookie (MEL); *MacBarron s.n.*, 21.iii.1951, Wodonga (NSW).

9. *P. viscosa* L., Sp. Pl. (1753) 183.

Type Citation: "Habitat in Virginia, Bonaria²".

Type Material: Not seen (Microfiche Herb. LINN, AD!).

An herbaceous *perennial* to about 30 cm high, with an extensive rhizomatous root system from which new plants arise. Sparsely pubescent with minute forked hairs (lens necessary). A few plants have bluntly conical hairs but then usually have a few forked hairs on the calyx margins. Lower *leaves* to 5 x 3 cm, ovate-lanceolate, upper *leaves* about 3 x 1 cm, lanceolate, apex acute, base cuneate, often oblique; *petiole* 0.5-2 cm long, narrowly winged above. Flowers solitary, pedicellate from leaf axils and stem forks. *Pedicel* c. 1 cm long. *Calyx* 9-10 mm long, divided about half way into triangular lobes, minutely pubescent. *Corolla* c. 13 mm long, 2-2.5 cm diam., rotate-pentagonal, petal apices broadly rounded, acumens c. 1 mm long, pale yellow with dark olive-yellow spots towards the base, densely pubescent below the spots and between the filaments. *Filaments* 3-5 mm long unequal, glabrous, white. *Anthers* 3-3.5 mm long, oblong, creamy white, pollen white. *Ovary* 2 mm diam. bluntly conical, disc conspicuous, fleshy, pale orange-yellow. *Style* c. 9 mm long, erect, glabrous. *Stigma* capitate, scarcely expanded. Fruiting calyx to 2 x 1.5 cm, enclosing berry. *Berry* c. 1 m diam. finally greenish yellow. *Seeds* 2-2.25 mm long, discoidal, light brown. *Cotyledons* c. 11 x 4 mm, lanceolate, minutely glandular pubescent towards the base, hypocotyl 1-1.5 cm long, minutely pubescent.

Distribution

See Map 5.

Notes

This species has become widely naturalised and weedy in southeastern Australia. Its identity has proved troublesome and Australian herbarium specimens have been labelled *P. angulata*, *P. macrophysa* and *P. lanceolata*. Waterfall (1958, p. 133) describes several varieties and forms, most of which are either much more pubescent, have more complex

hairs, or differ in leaf shape. However, material sent to him (ADW 40808, ex Wolsely, South Australia) was identified by him as *P. viscosa* with the comment that it best matched material from South America. A specimen at ADW, *Conrad 2363* collected near Santa Rosa, Argentina, identified by W. D'Arcy and distributed from Missouri Botanical Gardens matches the local material very well.

The specimens have frequently been collected from railway lines or yards. For an extended account of this species in Victoria see Parsons (1973, p. 263) under *P. lanceolata* Michx. where both a map of distribution and illustrations are given. Eichler (1965, p. 273) tentatively used the name *P. hederæfolia* Gray for this species.

Selected specimens

WESTERN AUSTRALIA: *Gardner s.n.*, Mch 1942, Bunbury, in waste places (PERTH).

QUEENSLAND (all cited): *Balderson s.n.*, 12.i.1936, Goomburra via Allora (BRI); *Kyle s.n.*, 16.ii.1936, Clifton, "Glenore", Leyburn Rd (BRI, CANB, NSW); *Roe 28*, 3.xii.1937, Goondiwindi (CANB, BRI); *O'Donnell s.n.*, 4.i.1940, Lowood (BRI); *Mengel s.n.*, 28.ii.1949, Felton, Cambooya (BRI); *Klose s.n.*, Apl 1958, Toowoomba (BRI);

NEW SOUTH WALES (selected from 42 specimens examined): *Milvain s.n.*, 28.v.1975, Lockhart (ADW, BRI, K, NSW); *Toms s.n.*, 7.iv.1978, Saverlake (ADW, NSW); *Horton s.n.*, 1979, ex Saverlake (ADW, CANB, NSW, MO).

VICTORIA (selected from 16 specimens examined; see map in Parsons, 1973, 263, sub *P. lanceolata*): *Aston 519*, 8.ii.1960, Kow Swamp, W of Gumbower (AD, MEL, K, NSW); *Smith 64/133*, 25.v.1964, Charlton Railway Yard (AD, MEL); *Pemberton s.n.*, 23.ii.1924, Horton Church, Leitchville (ADW, MEL).

SOUTH AUSTRALIA (all cited): *Black s.n.*, Feb. 1890, Dec. 1909, 13.i.1950, South Rd, Flagstaff (AD); *Johnson s.n.*, 29.iv.1941, Pt Noarlunga (AD); *Cleland s.n.*, 7.i.1950, nr Tapleys Hill (MEL); *Eichler 12166*, 23.ii.1956, Darlington, at foot of Tapley's Hill (AD, OKLA); *Dept of Agric. 524*, 24.v.1965, Wolsley (ADW); *Symon s.n.*, 15.xi.1966, grown from *Dept of Agric. 524*, ex Wolsley (AD, ADW, B, CANB, K, NSW); *Dept of Agric. 365*, Jan. 1969, Naracoorte (ADW); *Dept of Agric. 5954*, 1.ii.1972, Keith (ADW); *Garrick s.n.*, 1.iii.1972, Keith along railway line (AD, ADW, CANB, K).

10. SALPICHROA Miers

Miers in Hook., London Journ. Bot. 4 (1845) 321.

Scrambling or climbing soft-wooded *perennials*. *Leaves* alternate or opposite, simple, ovate shapes. *Pubescence* of simple hairs. *Flowers* solitary, pedicellate axillary. *Calyx* deeply 5-lobed. *Corolla* urceolate or tubular, 5-lobed. *Stamens* inserted about the middle of the corolla-tube. *Filaments* straight, glabrous. *Anthers* narrow, saggitate below, splitting along their full length. *Ovary* surrounded by annular fleshy disc. *Style* filiform. *Stigma* subcapitate. *Fruit* a berry, succulent, red or white. *Seeds* compressed, rugulose.

A genus of about 22 species from South America. One species has been widely cultivated as an ornamental and in many areas has become weedy.

1. *S. organifolia* (Lam.) Baill., Hist. Pl. 9 (1888) 288.

Physalis organifolia Lam., Tabl. Encycl. 2 (1797) 28. *Basionym*.

Type Citation: "Ex Magellania, An ph. curassavica. 1".

Type Material: Not seen.

Salpichroa rhomboidea (Hook.) Miers, London J. Bot. 4 (1845) 326.

Atropa rhomboidea Hook., Bot. Misc. 1 (1829) 135, t. 37. *Basionym*.

Type Citation: "I am indebted to Dr. Gillies not only for the specimens from which the accompanying figure is made, but also for a description made from the living plant in its native country".

Type Material: Not seen.

Common Name: pampas lily of the valley; cocks eggs.

Scrambling *perennial* to several m long with stout rootstock and rhizomes from which new plants emerge, older stems quadrangular with pale corky epidermis. Younger stems, twigs, petioles, upper and lower leaf surface sparsely or densely pubescent with antrorse, curved, several celled, simple hairs, unarmed. *Leaves* to 5 x 3 cm but mostly c. 1.5 x 1 cm, ovate to ovate-rhombic, entire, alternate in unequal sized pairs the smaller leaf c. $\frac{3}{4}$ the size of the larger; *petiole* 0.5-2.5 cm, mostly c. 0.7 cm. *Inflorescence* a solitary pendulous flower in the leaf axils. *Pedicel* 7-10 mm long slender, calyx tube c. 1.5 mm long, campanulate, the lobes c. 2 mm long, narrowly triangular. *Corolla* c. 7 mm long, urceolate, the lobes joined in a tube except at their apex which is c. 2 mm long, triangular, reflexed, glabrous except for minute papillose hairs at the apex, white or cream. *Filaments* adnate to the tube for most of their length the final 2-3 mm free; *anthers* c. 2 mm long, sagittate below, splitting along their full length, somewhat exserted. *Ovary* c. 2 mm long, broadly conical, glabrous, lower portion surrounded by a prominent annular fleshy disc. *Style* 5 mm long, erect, pubescent in lower half. *Stigma* capitate and not exceeding the anthers. *Berry* 13-18 x 7-8 mm, bluntly conical, succulent, aromatic, translucent when ripe, white to pale yellowish. *Seeds* about 2 mm diam., discoidal, hirsute if cleaned gently, with a narrow wing 0.25 mm wide along the margin, an average of 14 seeds per berry in seven fruit counted.

Distribution

In all States except Tasmania. Map 3.

Notes

A genus of about 25 species mainly in tropical America. One species was originally cultivated and is now naturalised in southern Australia, mostly found in urban areas and often difficult to eradicate because of its extensive root system. The earliest collections are from Victoria in 1916, but it was obviously soon distributed and was established in South Australia in 1925 and New South Wales by 1932. For an account of the species in South Australia see Richardson (1953) and in Victoria with map and illustrations see Parsons (1973). The common name pampas lily of the valley obviously refers to the similarity of the flowers to *Convallaria*; the name cocks eggs may have arisen from the similarity of the ripe fruit to cocks testicles, not seen so often since Col Sanders invaded Australia. For an account of the alkaloids in this species see Evans et al (1972).

Selected specimens

WESTERN AUSTRALIA (three collections seen): *Royce s.n.*, 20.ii.1953, Tuart Hill (K, PERTH); *Paterson s.n.*, 28.iii.1969, Perth (PERTH).

QUEENSLAND: *Wetherall s.n.*, 6.iii.1962, Ipswich, property of W. Roberts, York St (BRI).

NEW SOUTH WALES (selected from 29 specimens examined): *Rodway 953*, 21.xi.1932, Nowra, Bridge Rd, garden weed vigorous amongst other plants (NSW); *Pearson s.n.*, Mch 1941, Dubbo (NSW); *Matthews s.n.*, 13.v.1942, Corowa District (NSW); *Schmidt s.n.*, 21.vi.1943, Ungarie (NSW); *McLachlan s.n.*, Mch 1948, Canberra, weed in garden (CANB, NSW); *Moore s.n.*, Oct. 1948, Gooloogong (NSW); *Green s.n.*, Oct. 1949, Hunters Hill (NSW); *McLean s.n.*, 13.ii.1951, Orange district, growing on slate soil in backyard (NSW); *Curtin 252*, 6.x.1953, Forbes, common weed in garden (NSW); *Maitland Ware s.n.*, 28.ii.1957, Narrandera, in a garden in the town (NSW); *White s.n.*, 17.ii.1968, Condobolin, in domestic garden (NSW); *Whaite s.n.*, 3.iii.1973, Goulbourn, vacant land, Combermere St (NSW); *Allen s.n.*, Jan. 1974, Bourke, unused garden in town block (NSW).

VICTORIA (ten collections seen): *Semmens s.n.*, Jan. 1916, creeping in hedge at Black Rock (MEL); *French s.n.*, 17.iii.1919, Burnley & Camberwell, spreading (MEL); *Fricke s.n.*, May 1920-30, Sandringham (ADW); *Leaney s.n.*, May 1950, MacArthur-Byaduk district (ADW); *Beaughtole 30555*, 19.ii.1969, Grampians N of Wannon Bridge, N of Dunkeld, spreading (MEL); *Browne s.n.*, June 1977, Redcliffs township, neglected backyard (MEL); *Muir 5496*, 3.vi.1977, Glen Iris, Hayes Crescent, on waste land beside creek (MEL).

TASMANIA: *Woodforde s.n.*, 29.x.1951, Burnie, escape from cultivation (HO).

SOUTH AUSTRALIA (nine collection seen): *Ising s.n.*, Apl 1925, Adelaide, Marryatville Rd (AD); *Black s.n.*, Apl 1925, Adelaide, Kensington Rd (AD); *Eardley s.n.*, 1942, Hundred of Joanna, 16 miles E of Naracoorte at "Dunholm" on Vict. border (ADW); *Dunston s.n.*, 22.ii.1946, Payneham Rd, Adelaide (AD); *Tideman s.n.*,

1.iv.1959, Mrs Salmon's property c. 5 km NW of Berri on Monash Rd (AD, BM, K, L, NSW, UC); *Amisberg s.n.*, 26.viii.1971, Adelaide suburb, Royal Pk (AD, B, W); *Symon 11027*, 5.vii.1978, Adelaide suburb, Norwood, in waste place (AD, ADW, B, BH, CANB, K, L, MO).

11. WITHANIA Pauquy

Pauquy, Diss. Bellad. (1825) 14.

Shrubs. Leaves alternate or opposite, simple, entire. Pubescence of dendritic hairs. Flowers solitary or in axillary clusters. Calyx campanulate, 5-lobed. Corolla campanulate 5-lobed. Stamens 5, equal, inserted near base of corolla. Anthers erect, included. Style slender, erect. Stigma capitate. Fruit a globose berry enclosed in the inflated calyx. Seeds subreniform.

A small genus of about 10 species found in western Asia and north Africa. Although frequently placed near *Physalis* because of the inflated calyx there is little evidence that they are in any way related. Several species have long been grown as drug plants.

1. *W. somnifera* (L.) Dunal in DC., Prodr. 13 (1852) 453.

Physalis somnifera L., Sp. Pl. (1753) 182. *Basionym*.

Type Citation: "Habitat in Mexico, Creta, Hispania".

Type Material: Not seen.

A shrub to about 1 m tall, erect, sparsely branched, woody below. All parts grey pubescent with dendritic hairs, dense on stems, petioles, and young growth, sparse on older surfaces, unarmed. Leaves to 8 x 4.5 cm commonly about 5 x 3 cm, ovate, apex acute or obtuse, base shortly cuneate, petiole c. 1 cm long. Inflorescence a congested cluster of 4-6 flowers in the leaf axil. Pedicels 3-5 mm long; calyx tube c. 2 mm long, the lobes 2-3 mm long, shortly triangular and including the linear acumen. Corolla 5-6 mm long, the tube campanulate the linear stellate lobes cut to about the middle, drab yellowish green. Filaments c. 3 mm long, slender. Anthers 1 mm long, ovate. Ovary bluntly conical, glabrous. Style 3 mm long, erect; stigma capitate. Berry 5-10 mm diam. globular, shining red, succulent included within the inflated calyx tube 1.5-2 cm long, orifice small, the apex of the calyx lobes scarcely enlarged. Seeds irregular discoid about 2 mm long, light brown, minutely reticulate, about 35 per berry.

Notes

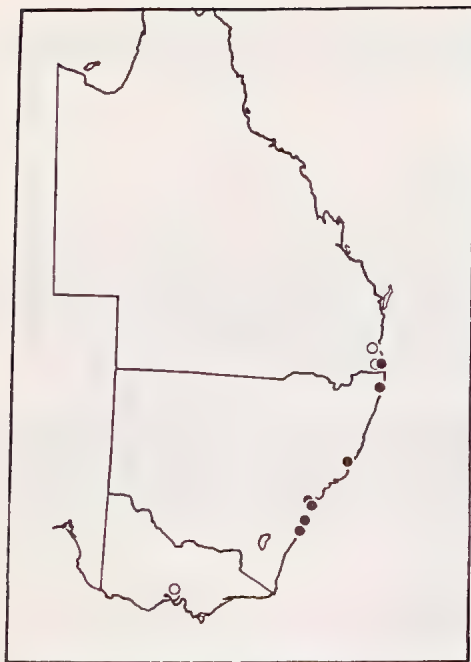
This genus of about 10 species occurs in North Africa and in the Mediterranean basin eastwards to India where it is cultivated as a drug plant (Atal & Schwerting, 1962).

A single species is locally established near Port Lincoln, S.A. (Johnston, 1949) and in NSW. In both cases the plants appear to grow on shallow rocky soils.

Specimens examined (all cited)

NEW SOUTH WALES: *Doyle s.n.*, Sept. Eden Vale, Vacy (NSW); *Readett s.n.*, 13.vi.1966, Glendonbrook Creek, Myall Reserve, few plants on rocky knoll (NSW).

SOUTH AUSTRALIA: *Johnston s.n.*, Mch 1949, Pt Lincoln (ADW); Nov. 1950, Dec. 1950, "The Duckponds" nr Pt Lincoln (AD); *Alcock 504*, 21.ii.1965, "Tulka", nr Pt Lincoln (AD); 11.iv.1965, "Tulka", Hd of Sleaford, Sect. 519 (ADW); *Symon 11837*, 27.ix.1979, Eyre Peninsula, nr Tulka S of Pt Lincoln (AD, ADW, CANB, K, MO, PERTH; cutting from this collection cultivated ADW).



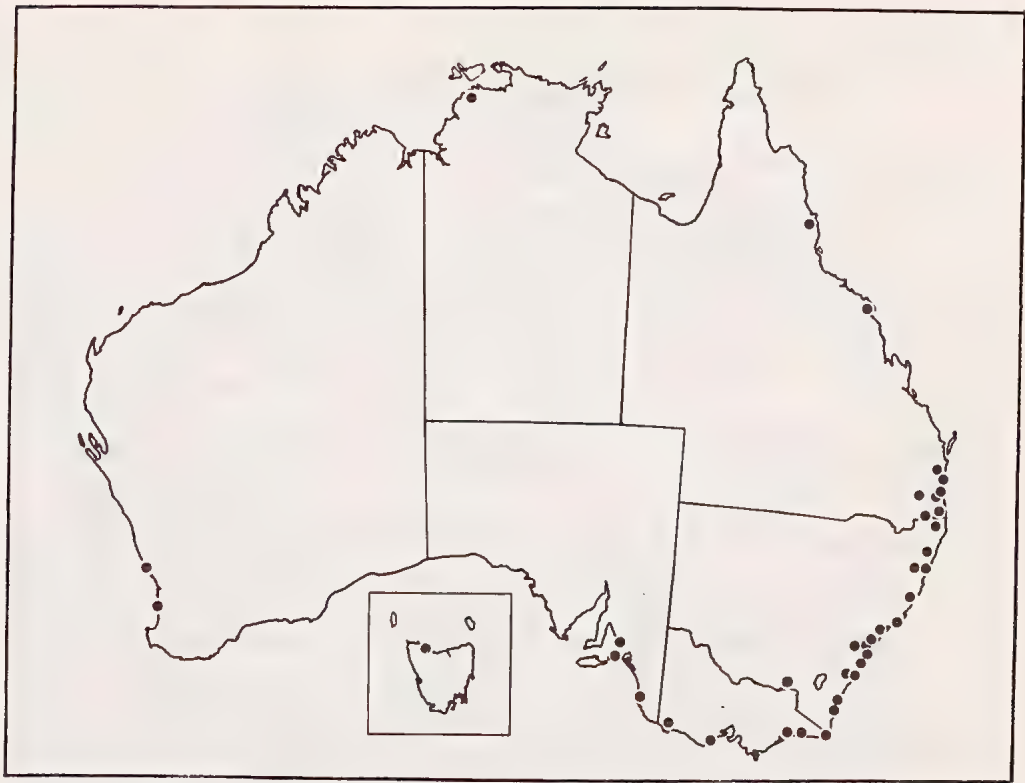
Map 1. Distribution of *Cestrum aurantiacum* (spots) and *C. elegans* (circles).



Map 2. Distribution of *Cestrum parqui*.



Map 3. Distribution of *Salpichroa organifolia* (spots) and *Capsicum annuum* var. *glabriusculum* (circles) and *C. frutescens* (triangles).



Map 4. Distribution of *Physalis peruviana*.



Map 5. Distribution of *Physalis viscosa* (spots), *P. virginiana* (circles) and *P. lanceifolia* (triangles).



Map 6. Distribution of *Physalis minima* (spots) and *P. ixocarpa* (circles).

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A REVISION OF THE GENUS *STREPTOGLOSSA* (ASTERACEAE: INULEAE)

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Abstract

Streptoglossa Steetz in F. Muell. is the correct name for the genus currently known as *Pterigeron* (DC.) Benth. Eight species are recognised, all endemic to Australia. The following new combinations are made: *S. macrocephala* (F. Muell.) Dunlop, *S. decurrens* (DC.) Dunlop, *S. odora* (F. Muell.) Dunlop, *S. bubakii* (Domin) Dunlop, *S. liatroides* (Turcz.) Dunlop, *S. adscendens* (Benth.) Dunlop, *S. cylindriceps* (Black) Dunlop. *S. tenuiflora* Dunlop is described as new.

Introduction

The first recorded collection of the genus was by Nicolas Baudin from Western Australia between 1801 and 1803. This was described by A.P. De Candolle (1836) under *Erigeron* (*Pterigeron*) *decurrens*. Asa Gray saw Baudin's specimen in Paris and recognised this species and *Erigeron liatroides* Turcz. (Turczaninow, 1851) as congeners and made the following comment in a footnote in 'Plantae Wrightianae' (Gray, 1852): "Decandolles *Erigeron*? (*Pterigeron*) *decurrens* belongs to the tribe Cynareae in which, with a second and larger-flowered species from tropical New Holland, it forms a new genus".

F. Mueller was unaware of these early publications, placing subsequent collections of the genus under *Pluchea* sect. *Rhodanthemum* (Mueller, 1859a). He had also sent specimens to Joachim Steetz who pointed out sufficient differences to exclude the taxon from *Pluchea* and proposed the new genus, *Streptoglossa*. Mueller published *Streptoglossa* with Steetz's accompanying description (Mueller, 1863), prefacing the description with the following: "... the following genus ... I regarded ... as a subgenus of *Pluchea* to which I had assigned ... the name *Rhodanthemum*". Concurrently, Mueller published the combination *Streptoglossa steetzii* though a specimen was not cited. There is no doubt however, taking into account Mueller's reference above and Steetz's detailed description, that *Streptoglossa* and *Pluchea* sect. *Rhodanthemum* refer to the same taxon.

The type specimen of the type species of *Streptoglossa* has not been found. Steetz's detailed description of a specimen sent to him by Mueller described the capitula as having 15-20 florets, effectively precluding all species except *Streptoglossa odora* and possibly *S. adscendens*. This is a very small head, even for *S. odora* and the author has not seen *S. adscendens* with fewer than 20 florets. One of Mueller's specimens of *S. odora* from Depot Creek, Northern Territory, has 15 florets per capitulum and it has been assumed that Steetz had a duplicate of this in hand.

Bentham (1867), in his treatment of the genus, gave priority to De Candolle's name, *Pterigeron*. It was not until this reinstatement that *Pterigeron* was validly published as a generic name. A. Gray's reference quoted above does not satisfy the conditions outlined in the ICBN for the valid publication of *Pterigeron* as a genus. Bentham's adoption of *Pterigeron* in preference to *Streptoglossa* was contrary to Art. 11 of ICBN (1978), and must be rejected.

Section *Oliganthemum* F. Muell. of *Pluchea* Less. was established by Mueller (1859b) containing one species, *Pluchea filifolia*. Bentham (*op. cit.*, p. 533) included this species in *Pterigeron*, citing *Oliganthemum* as a generic synonym. Subsequent authors have continued to follow Bentham though Airy Shaw (1973) has listed *Pterigeron* as a

synonym of *Oliganthemum*. To the knowledge of the author, *Oliganthemum* has never been validly published as a generic name. *Pterigeron filifolius* (F. Muell.) Benth. is transferred to a new monotypic genus in an accompanying paper (Dunlop, 1981).

Subsequent to Bentham's revision three more species were added to *Pterigeron*: one each by Mueller (1875), Black (1915) and Domin (1929). Mueller's species, *Pterigeron dentatifolius*, is not closely related to other members of the genus and has been transferred to the monotypic genus *Dichromochlamys* Dunlop (Dunlop, 1980).

Affinities

Streptoglossa has traditionally been placed in the Inuleae, subtribe Pluchinae (Bentham, 1873; Bentham and Hooker, 1873; Hoffmann, 1889; Randeria, 1960) where it has been allied with such genera as *Pluchea*, *Blumea*, *Laggera* and *Coleocoma*. In the most recent review of the Inuleae (Merxmüller *et al.*, 1977), the Pluchinae have been placed under an expanded Inulinae where *Streptoglossa* and closely related genera form the informal *Pluchea* group. Within this group *Streptoglossa* is distinguished by ligulate marginal florets, a feature it shares with *Allopterigeron* Dunlop. A discussion of the differences between these two genera is provided in a revision of *Allopterigeron* (Dunlop, 1981).

Within *Streptoglossa*, two natural groups are evident. These groups are clearly divided morphologically and to some extent geographically:

1. *S. bubakii*, *S. macrocephala*, *S. decurrens*, *S. odora*. All these species have a northerly distribution, are strongly odorous and are densely glandular. With the exception of *S. macrocephala*, the glands are predominantly on long stipes. None of the species possesses the minute glands of the receptacle found in two species (*S. adscendens*, *S. liatroides*) of the second group. The last three species have decurrent leaves, two species (*S. macrocephala*, *S. decurrens*) are long-lived shrubs and the others are perennial suffrutescent herbs.
2. *S. adscendens*, *S. cylindriceps*, *S. liatroides*, *S. tenuiflora*. The centre of distribution of *S. adscendens* is central and southern Australia; *S. cylindriceps* and *S. liatroides* are centred in southern and south-western Australia; *S. tenuiflora* is localised in Western Australia. None of the species possesses a strong odour, all are sparsely glandular (relative to group 1) and have glands which are nearly sessile or on short stipes. None of the species has decurrent leaves or is long-lived and shrubby.

Note on Trichome Types

All species of *Streptoglossa* possess glandular and non-glandular trichomes. The glandular trichomes may be further categorized according to whether they are stipitate or sessile or have unicellular or multicellular tips. Throughout this paper these trichomes are referred to as *glands* with no distinction being made between the types. In general the glands of the leaves and stems are quite prominent on long stalks while those of the floral parts are minute and easily overlooked.

The term "glandular hair" has been avoided so it is understood that all adjectives referring to the vestiture of the plant refer to the non-glandular trichomes. The non-glandular trichomes or *hairs* may be simple or multicellular and occur with the glands on the vegetative parts but are sparse or lacking on the floral parts.

STREPTOGLOSSA Steetz in F. Muell.

Streptoglossa Steetz in F. Muell., Trans. Proc. Bot. Soc. Edinburgh 7:491 (1863).

Type: *S. steetzii* F. Muell. [= *S. odora* (F. Muell.) Dunlop].

Erigeron sect. *Pterigeron* DC., Prod. 5:293 (1836).

Pterigeron (DC.) Benth., Fl. Aust. 3:531.1867; Bailey, Qld Fl. 3:818 (1900); Black, Fl. S. Aust. 4:892 (1957).

Type: *Erigeron decurrens* DC.

Pluchea sect. *Rhodanthemum* F. Muell., Rep. Babb. Exped. 12 (1859).

Type: *Pluchea ligulata* F. Muell.

[*Pluchea* sect. *Oliganthemum* auct. non. F. Muell. (1859b); Benth. Fl. Aust. 3:533 (1867); Bailey, Qld. Fl. 3:818 (1900)].

Shrubs or annual or perennial *herbs*. Vegetative parts aromatic or odourless, covered in varying degrees with uniseriate multiseptate trichomes and biseriate stipitate glands; glands in some species on long multiseptate stalks; in others on minute stalks, appearing sessile. *Stems* prostrate, ascending or erect. *Leaves* simple, cauline, alternate, sessile, the bases attenuate, decurrent or stem-clasping; shapes various; margins entire or serrate; venation obscure except for midrib; stomatal pattern anomocytic. *Capitula* heterogamous, solitary on long or short branches, scattered or in loose terminal clusters. *Phyllaries* in several series, rigid, imbricate, ovate to narrow lanceolate, becoming narrower towards the inside; apices mainly acute to acuminate, in one species cuspidate; outer surface glabrous or variously pubescent and glandular; persistent, recurved on drying, never wholly reflexed. *Receptacle* flat, variously sculptured, without palea, glabrous or sparsely pilose, glandular or non-glandular. *Florets* all fertile, the tips of the corollas and exerted parts of anthers and stigmas pink to purple. *Marginal florets* female, in several series, ligulate or the corolla tube regularly or irregularly lobed, the dorsal surface of the ligules and lobes glabrous, rarely sparsely pilose, glandular or non-glandular; style bulbous at base, the stigmatic branches filiform. *Disc florets* bisexual, corollas regularly 5- or 4-lobed, the dorsal surface of upper part of tube and lobes glabrous or sparsely pilose, glandular or non-glandular; lobe apices ventrally papillate; style bulbous at base, shortly branched, strongly papillate in the upper part. Stamens adnate to base of corolla tube, the collar of thickened cells below the anther well developed; anthers tailed; distal appendage of connective obtuse. *Achenes* terete; pericarp red-brown, coriaceous, covered in varying degrees with duplex hairs, with or without superficial pale coloured ribs. Carpopodium pale coloured, annular. *Pappus* setae numerous, in 1-3 series, about as long as corolla, connate at base, white or yellowish, plumose-setose, persistent.

Distribution

Mainland states of Australia (excluding Victoria) and the Northern Territory.

Key to Species

- 1a. Leaves, at least those of the primary stem, markedly decurrent (more than 4 mm) or stem-clasping . . . 2
- b. Leaves simply sessile or only slightly decurrent (less than 2 mm) on stem 4
- 2a. Involucres 1.5 cm or more long; marginal florets without ligules 1. *S. macrocephala*
- b. Involucres less than 1.5 cm long; marginal florets ligulate 3
- 3a. Leaves on primary stem 1-3 cm wide; 45-80 florets per capitulum; capitula usually in terminal clusters 2. *S. decurrens*
- b. Leaves on primary stem rarely more than 1 cm wide; 15-30 (rarely more than 45) florets per capitulum; capitula scattered 3. *S. odora*
- 4a. Leaves all linear or oblanceolate, to 3 mm wide 3. *S. odora*
- b. Leaves not all linear or if oblanceolate broader than 3 mm 5
- 5a. Median phyllaries densely glandular; fresh plants pungently odorous 6
- b. Median phyllaries with few scattered glands or non-glandular; plants never pungently odorous 7
- 6a. Outer and median phyllaries without non-glandular multiseptate hairs; phyllaries straw coloured, never purple-tipped; involucres 1.5 cm or more long 1. *S. macrocephala*
- b. Outer and median phyllaries villous; phyllaries green, often purple-tipped; involucres less than 1.5 cm long 4. *S. bubakii*

- 7a. Involucres less than 1.3 cm long 8
- b. Involucres 1.3 cm or more long 10
- 8a. Receptacles non-glandular 5. *S. tenuiflora*
- b. Receptacles glandular 9
- 9a. Capitula mostly terminating branches longer than 3 cm; plants sparsely and openly branched; ligules conspicuous, 3-6.7 mm long 6. *S. liatroides*
- b. Capitula terminating branches up to 3 cm long; plants much branched, compact; ligules inconspicuous, 1-2 mm long 7. *S. adscendens*
- 10a. Median phyllaries glabrous; receptacles non-glandular 8. *S. cylindriceps*
- b. Median phyllaries glabrescent to villous; receptacles glandular 6. *S. liatroides*

1. *Streptoglossa macrocephala* (F. Muell.) Dunlop, comb. nov.

Pluchea macrocephala F. Muell., Rep. Babb. Exped. 12 (1859), *basionym*.

Type: Gulf of Carpentaria, *F. Mueller s.n.*, 1856 (MEL 42579, lectotype here designated). Fitzmaurice R., *F. Mueller s.n.*, -x.1855 (MEL 42585, syntype).

Pterigeron macrocephalus (F. Muell.) Benth., Fl. Aust. 3: 532 (1867); Bailey, Qld Fl. 3: 819 (1900).

Pterigeron microglossus Benth., Fl. Aust. 3: 532 (1867), *nom. illeg.*, *p.p.* (*quoad specim.* Fitzmaurice R., *F. Mueller s.n.*, K, syntype); Bailey, Qld Fl. 3: 820 (1900).

Shrub to 1 m; vegetative parts strongly aromatic, pilose to glabrescent (stems sometimes villous), densely glandular, often slightly vernicose, glands on short stipes. *Stem* erect, diffusely branched; current season's branches leafy, older branches leafless, rough with residual leaf bases. *Leaves* ovate, elliptic, oblong or oblanceolate, acute or obtuse; bases stem-clasping or less often attenuate, 1-3.8 cm long, 0.4-1.5 cm wide; margins often slightly recurved, wholly entire or only towards the base or serrate or with shallow lobes; the trichomes of the leaf often confined to margin and midrib. *Capitula* few together in loose corymbs, often enveloped by upper leaves; florets 60-100, disc fewer or more than marginal. *Involucre* 1.5-2 cm long. Outer and median *phyllaries* ciliate, densely glandular; inner series ciliate, sericeous with simple hairs, glandular or non-glandular. *Receptacle* fimbriate, glabrous, non-glandular. *Marginal florets* filiform, straight or bent in upper part, 5-(6-) or 4-lobed, the lobes equal or nearly so, glabrous, non-glandular. Corollas of *disc florets* 9-12 mm long, 5-lobed, glabrous, sparsely glandular. *Achenes* 3-4.5 mm long, densely sericeous, with 7-9 ribs. *Pappus* in c. 3 series.

Distribution

Northern Territory, Queensland and Western Australia. Map 2.

Selection of Specimens Examined

NORTHERN TERRITORY: 14 miles SE of Willowra Homestead, *G.M. Chippendale* NT 4728, 29.vii.1958 (CANB, MEL, NSW, NT, PERTH); Lake Nash, *M. Costello s.n.*, -iii.1896 (BRI); 36 miles S of The Granites, *C.R. Dunlop* 1780, 30.vii.1970 (BRI, NT); 78 miles WNW of Tanami, *C.R. Dunlop* 2331, 13.ix.1971 (AD, DNA, NT); central Mt Stuart, *A.J. Ewart s.n.*, -vii.1924 (MEL); Barrow Creek, *E. Gauba s.n.*, 6.x.1950 (CBG, NSW, includes *S. liatroides*); 89 miles SSW of Hooker Creek, *C.H. Gittins* 2263, 7.viii.1971 (NT); 56 miles E of Frewena, *N.M. Henry* 196, 21.vii.1971 (BRI, CBG, NT, PERTH); Ti-Tree Well (Tea Tree), *R. Hill & H.W. Caulfield s.n.*, -vii.1953 (AD); 40 miles E of The Granites, *H.A. Johnson s.n.*, -vii.1957 (NT); 62 km S of Tennant Creek, *P.K. Latz* 1840, 17.xi.1971 (NT); Murray Downs, *T.R.N. Lothian* 548/54, 1954 (AD); Fitzmaurice R., *F. Mueller s.n.*, -x.1855 (K, syntype of *Pterigeron microglossus*; MEL 42585, syntype of *Pluchea macrocephala*); 20 miles S of Tennant Creek, *D.J. Nelson* 1524, 27.vii.1967 (AD, CBG, NSW, NT); 90 miles WSW of Lake Nash, *R.A. Perry* 909, 22.v.1948 (CANB, two sheets); near The Granites, *Terry Exped. s.n.*, 25.vii.1928 (MEL).

QUEENSLAND: Oban, *S.L. Everist* 3366, 5.xii.1947 (BRI, CANB); Gulf of Carpentaria, *F. Mueller s.n.*, 1856 (MEL 42579, syntype of *Pluchea macrocephala*); Georgina R., *E. Whilan s.n.*, undated (BRI).

WESTERN AUSTRALIA: c. 100 miles E of Anna Plains, *W.H. Butler s.n.*, -viii.1963 (PERTH); Nine Mile Ridge, East Kimberley, *W.V. Fitzgerald s.n.*, -ix.1906 (NSW); Goose Hill, East Kimberley, *W.V. Fitzgerald* 1604, -ix.1906 (PERTH); Minilya R., *C.A. Gardner* 3206, 23.viii.1931 (PERTH); 52 miles W of Jupiter Well,

A.S. George 9092, 29.vii.1967 (PERTH); between Alfred and Marie Ra. and Rawlinson Ra., *E. Giles s.n.*, undated (1876) (MEL); N of Balgo Mission, P.K. Latz 4043, 20.vii.1973 [CANB, DNA, NT, PERTH (n.v.)]; 26 miles ENE of Broome, M. Lazarides 6584, 25.ix.1959 (CANB, PERTH); 16 miles E of Carlton, R.A. Perry & M. Lazarides RAP 2657, 29.vii.1949 (AD, BRI; CANB, two sheets; MEL, NSW, NT, PERTH); Roebuck Bay, J. Tepper 38, -ix.1889 (MEL, PERTH).

Notes

Mueller cited two collections when describing *Pluchea macrocephala*, one from Fitzmaurice R. and the other from the Nicholson and Flinders Rivers. A specimen with the latter locality was not found though a collection of Mueller's labelled "Gulf of Carpentaria 1856" and annotated by Mueller is undoubtedly the syntype cited. This collection has been designated the lectotype. The collection from Fitzmaurice R. (along with a collection of *S. liatroides*) was later cited by Bentham in naming *Pterigeron microglossus*.

Leaf shape in *S. macrocephala* is variable. Some specimens show quite narrow oblanceolate leaves with attenuate bases (Perry & Lazarides 2657) though the majority are consistently ovate to oblong with stem-clasping bases. None of the specimens examined in this revision shows the two leaf types on the one plant though intermediate forms (Nelson 1524) do exist.

In the Northern Territory the occurrence of *S. macrocephala* is centred in the red sand plain country which extends across the Territory in the region of 21° south latitude and includes the Tanami Desert. It is found in similar country in western Queensland at the same latitude.

2. *Streptoglossa decurrens* (DC.) Dunlop, comb. nov.

Erigeron decurrens DC., Prod. 5:293 (1836), *basionym*.

Type: "cote occidentale . . . n(ouv)elle Hollande", N. Baudin s.n., undated (1800-1803) [P, holotype (n.v.); NT, photo].

Pterigeron decurrens (DC.) Benth., Fl. Aust. 3: 531 (1867).

Shrub to c. 70 cm; vegetative parts strongly aromatic, pilose to villous, densely glandular; glands on long and short stipes. *Stem* erect, leafy or the older branches leafless with residual leaf scars. *Leaves* oblong, elliptic or rarely oblanceolate, acute; bases decurrent; leaves of the stem and main branches 2-6 cm long, 0.8-2.3 cm wide, leaves of the branchlets 0.8-2 cm long, 0.2-0.6 cm wide; margins entire or serrate; several narrow leaves subtend capitula. *Capitula* usually in corymbose clusters on lateral branches; florets 45-80, disc fewer than marginal. Involucre 0.8-1.4 cm long. Several of the outer *phyllaries* with leaf-like tips, outer and median ciliate, pilose, densely glandular, inner glabrous or glabrescent, usually ciliate, glandular or non-glandular. *Receptacle* areolate, glabrous, non-glandular. *Marginal florets* ligulate, ligules 1.5-3 mm long, regularly or irregularly 3- or 4-lobed, one lobe often more deeply incised; glabrous, non-glandular. *Corollas of disc florets* 6-7 mm long, 5-lobed, glabrous, usually non-glandular. *Achenes* 2-2.5 mm long, densely sericeous, without ribs. *Pappus* in 2 or 3 series, setae of the outer series, if present, very short.

Distribution

Northern Territory, Queensland and Western Australia. Map 1.

Selection of Specimens Examined

NORTHERN TERRITORY: near Haasts Bluff, N.T. Burbidge & M. Gray NT B4280, 24.ix.1955 (CANB, NT, PERTH); near Mt Liebig, G.M. Chippendale NT 3563, 23.vii.1957 (NT, CANB); Yuendumu, C.R. Dunlop 2341, 14.ix.1971 (NT); Glen of Palms (Finke R.), E. Giles s.n., 1872 (MEL); Heavitree Ra., C.H. Gittins 2007, -ix.1969 (BRI); Mt Pantom, R. Helms s.n., 1896 (PERTH); Finke R., H. Kempe 178, -xii.1879 (MEL); 2 miles S of Hermannsburg, P.K. Latz 3131, 20.vii.1972 (NT); Mt. Gillen, P.K. Latz 4529, 26.vii.1973 (DNA, NT); 4 km

NNW of Santa Teresa Mission, *P.K. Latz 5832*, 26.xi.1974 (ADW, NT); near Haasts Bluff, *T.G.H. Strehlow s.n.*, 1932-1933 (AD); Laura Vale, *W. Tietkens s.n.*, 1889 (AD, MEL); Loves Ck, *S.A. White s.n.*, 15.ix.1913 (AD).

QUEENSLAND: Ardmore, *S.L. Everist 3251*, 23.xi.1947 (BRI, CANB); Cloncurry, *V. Scarth-Johnson 512*, 27.viii.1970 (BRI).

WESTERN AUSTRALIA: "cote occidentale . . . n(ouv)elle Hollande," *N. Baudin s.n.*, undated (1801-1803) [P, holotype, (n.v.); NT, photo]; near Gascoyne Junction, *J.S. Beard 6030*, 18.viii.1970 (NSW); Millstream, *M.I.H. Brooker 2116*, 26.ix.1969 (PERTH); Wallal Downs, *N.T. Burbidge 1506*, 20.vii.1941 (PERTH); Barrow Is., *B. Clay & M. Yardau s.n.*, 21-24.xi.1965 (PERTH); N of Mt Tom Price, *M. Cole WA5116*, 1.ix.1963 (PERTH); Harding R., *W.A. Cusack 163*, 1895 (PERTH); Yule R., *J. Forrest s.n.*, 1878 (MEL, PERTH); Minilya R., *J. Forrest s.n.*, 1882 (MEL, two sheets); 6 miles N of Roebourne, *C.A. Gardner 6343*, 18.x.1941 (PERTH); De Grey R., *C.A. Gardner 8098*, 8.ix.1946 (PERTH); Monte Bello Is., *Hill s.n.*, 12.xi.1953 (CANB); Depuch Is., *R.D. Royce 7128*, 30.v.1962 (PERTH); Kennedy Ra., *C. Teichert s.n.*, -ix.1948 (MEL); Nickol Bay, *P. Walcott & H. Brown s.n.*, 1861 (MEL).

Notes

S. decurrens is closely related to *S. odora* and is not always easily distinguished from it. The leaves of *S. odora* are generally narrower with leaves of up to 1 cm wide occurring only on the central stem. The leaves of the branchlets are usually narrow linear in *S. odora* and oblong to elliptic in *S. decurrens*. In the Northern Territory *S. decurrens* is confined mainly to the scree slopes and gorges of the Central Australian ranges, while *S. odora* has a more northerly distribution and grows in a variety of habitats.

In both species the gland tips are red-brown, distinguishing them from all other species which have pale yellow gland tips.

3. *Streptoglossa odora* (F. Muell.) Dunlop, comb. nov.

Pluchea odora F. Muell., Rep. Babb. Exped. 12 (1859), *basionym*.

Type: Depot Ck, Victoria R., *F. Mueller s.n.*, -iii.1856 (MEL 42595 *p.p.*, lectotype here designated); Baines Ck, *F. Mueller s.n.*, -v.1856 (MEL 42596, syntype); Victoria R., *F. Mueller s.n.*, undated (MEL 42543, syntype).

Pterigeron odoratus (F. Muell.) Benth., Fl. Aust. 3: 532 (1867); Bailey, Qld Fl. 3: 819 (1900).

Streptoglossa steetzii F. Muell., Trans. Proc. Bot. Soc. Edinburgh 7: 491 (1863).

Type: not designated; possibly syntype of *Pluchea odora* F. Muell. (probably lost).

Pterigeron odoratus var. *major* Benth., Fl. Aust. 3: 532 (1867), *p.p.* (quoad specim. Albert R., ?*Henne s.n.*, undated [K (n.v.)], syntype; MEL 42597, dated 1861, probable isosyntype).

Perennial suffruticose *herb* to 60 cm; vegetative parts strongly aromatic, pilose to villous, densely glandular, glands on long and short stipes. *Stem* erect, leafy. *Leaves* of the stem and main branches oblanceolate, rarely linear, acute, bases decurrent or obscurely so in narrow linear leaves, 1.5-5.5 cm long, 0.4-0.8 (1.5) cm wide, margins entire or irregularly serrate; leaves of the branchlets narrow linear, oblong or oblanceolate, 0.5-1.5 cm long, 0.1-0.4 cm wide, margins entire or serrate; several narrow leaves subtend capitula. Rarely leaves of the whole plant narrow linear. *Capitula* on long or short branches, scattered; florets 15-30 (rarely to 60), disc fewer than marginal. *Involucre* 0.8-1.1 cm long. Several of the outer *phyllaries* with leaf-like tips, outer series ciliate towards the base, pilose, densely glandular; median ciliate, glabrous or glabrescent, densely glandular; inner ciliate, glandular towards the apices. *Receptacle* alveolate-fimbriate, glabrous, non-glandular. *Marginal florets* ligulate, ligules 1-3 mm long, regularly or irregularly 2-4-lobed, glabrous, usually non-glandular. Corollas of *disc florets* 5-6.5 mm long, 5-lobed, glabrous, usually non-glandular. *Achenes* 2-3 mm long, densely sericeous, without ribs. *Pappus* in 3 series, setae of the outer series short.

Distribution

Northern Territory, Queensland and Western Australia. Map 2.

Selection of Specimens Examined

NORTHERN TERRITORY: c. 5 miles W of Anitowa H.S., *G.M. Chippendale* NT 3145, 23.x.1956 [AD (n.v.), BRI, CANB, MEL, NSW, NT, PERTH]; Eva Downs and Ashburton Ra., *L. Ditttrich s.n.*, -ix.1886 (MEL, includes *S. bubakii*); Mongrel Downs, *C.R. Dunlop* 2109, 20.iv.1971 (NT); 90 miles NW of Camp 111, *G.F. Hill s.n.*, 15.vi.1911 (MEL, NSW); 14 miles SSW of Goyder R. crossing, *P.K. Latz* 3115, 3.vii.1972 (CANB, NSW, NT); c. 5 miles E of Undoolya Gap, *P.K. Latz* 3145, 27.vii.1972 (DNA, MEL, NSW, NT); Depot Ck, Victoria R., *F. Mueller s.n.*, -iii.1856 (MEL 42595); Baines Ck (R.), *F. Mueller s.n.*, -v.1856 (MEL 42596, syntype of *Pluchea odora*); Victoria R., *F. Mueller s.n.*, undated (MEL 42543, syntype of *Pluchea odora*); Roper R., *F. Mueller s.n.*, undated (1856) (K, syntype of *Pterigeron adscendens*).

QUEENSLAND: Etheridge R., *E. Armit* 605, undated (BRI; MEL, two sheets); Boulia, *S.T. Blake* 6477, 28.vi.1934 (BRI); Delta Downs, *S.T. Blake* 12528, 14.viii.1936 (BRI); Hughenden, *W.D. Francis s.n.*, -v.1934 (BRI); between Norman and Gilbert Rivers, *J. Gulliver* 84, 1874 (MEL); Lynd R., *W. Hann* 9, -xii.1873 (K); Albert R., *?Henne s.n.*, undated [MEL; K, (n.v.)], syntype of *Pterigeron odoratus* var. *major*; New Highland Plains H.S., *P.K. Latz* 1615, 23.vii.1971 (MO, NT); 56 km SE of Cloncurry, *J.R. Maconochie* 1639, 26.viii.1972 (DNA, NT); Bowen Downs, *F. Mueller s.n.*, undated (MEL); 18 miles W of Canobie, *N.H. Speck* 4780, 31.vii.1954 (BRI; CANB, two sheets; MEL, NSW, NT); Ravenswood dist., *F. Tinsley s.n.*, 30.x.1933 (BRI).

WESTERN AUSTRALIA: Goody Goody, *W.V. Fitzgerald* 242, -iv.1905 (PERTH); near Mt House, *W.V. Fitzgerald* 955, -v.1905 (PERTH); Isdell R., *W.V. Fitzgerald* 1477, -ix.1905 (PERTH); Port Hedland, *W.V. Fitzgerald s.n.*, -x.1905 (NSW); Depot Pool, *A. Forrest s.n.*, 1879 (MEL); Pentacost Ra., *J.R. Maconochie* 156, 19.v.1967 (NT); near Broome, *W. Mjoberg s.n.*, -vii.1911 (NSW); Margaret and Ord Rivers, *Turner s.n.*, 1884 (MEL).

Notes

The lectotype of *Pluchea odora* was chosen from several specimens collected by Mueller near Victoria R. It is the only collection available to Steetz which closely fits his description of *Streptoglossa*. By inference, Mueller based the name *Streptoglossa steetzii* on the same specimen.

The type of *Pterigeron odoratus* var. *major* consists of a specimen (*Bowman* 102) of *S. bubakii* and another which falls into the normal range of variation of *S. odora*. When citing the latter specimen, from Albert R., Bentham named Mueller as the collector though the probable duplicate (MEL 42597) is dated 1861. As this is the year Henne collected in the Gulf of Carpentaria, it is possibly one of his specimens.

4. *Streptoglossa bubakii* (Domin) Dunlop, comb. nov.

Pterigeron bubakii Domin, Bibl. Bot. 89: 1217 (1929), *basionym*.

Type: north west Aust. between Ashburton and De Grey Rivers, *E. Clement s.n.*, undated (1897) (K, holotype).

Pterigeron odoratus var. *major* Benth. Fl. Aust. 3:532 (1867), *p.p.*, (quoad specim. *Suttor* R., *E. Bowman* 102, undated [K (n.v.)], syntype; MEL 42598).

Perennial suffruticose herb to c. 70 cm; vegetative parts strongly aromatic, pilose to villous, densely glandular, glands on long and short stipes. Stem erect or ascending, leafy, the larger plants profusely branched and compact. Leaves oblanceolate or obovate, acute, obtuse or rounded, bases attenuate, 1-7 cm long, 0.2-1.8 cm wide; margins entire or serrate. Capitula on long, rarely short branches, towards the top of the plant; florets 40-100, disc fewer than marginal. Involucre 1-1.5 cm long. Several of the outer phyllaries with leaf-like tips, outer and median series ciliate, villous, densely glandular; inner ciliate, pilose, glandular. Receptacle alveolate-fimbriate or foveolate, sparsely pilose, rarely glabrous, non-glandular. Marginal florets shortly ligulate or more usually 3-6-lobed, the lobes equal or nearly so, glabrous or sparsely pilose, glandular. Corollas of disc florets 5-7 mm long, 5-lobed, sparsely pilose, rarely glabrous, glandular. Achenes 2.5-3.5 mm long, sericeous, with 8-10 ribs. Pappus in 3 series, the outer setae short.

Distribution

Northern Territory, Queensland and Western Australia. Map 3.

Selection of Specimens Examined

NORTHERN TERRITORY: 11 miles NW of Alexandria, *G.M. Chippendale* in NT 7148, 9.vi.1960 (AD, CANB, K, MEL, NSW, NT, TTC); 38.7 miles SE of Ranken, *G.M. Chippendale* in NT 7247, 20.vi.1960 (AD, MEL, NSW, NT, PERTH); Eva Downs and Ashburton Ra., *L. Dittrich s.n.*, -ix.1886 (MEL, includes *S. odora*); Mongrel Downs, *C.R. Dunlop* 2110, 20.iv.1971 (NT); Tarlton Ra., *C.R. Dunlop* 2549, 20.v.1972 (MO, NSW, NT); Wycliffe Well, *A.J. Ewart s.n.*, -vi.1924 (MEL 42595; MEL 42603, includes *S. odora*); SSW of Highland Plains, *P.K. Latz* 1660, 26.vii.1971 (AD, CANB, NSW, NT, PERTH, TTC); 0.75 miles N of Katherine airport, *P.K. Latz* 3115B, 3.vii.1972 (CANB, NSW, NT); Lat. 18°00' 00", *J. Macd. Stuart s.n.*, undated (MEL).

QUEENSLAND: N. Hughenden, *S.T. Blake* 12662, 24.vii.1936 (BRI); Suttor R., *E. Bowman* 102, undated (MEL); 40 miles N of Julie Creek, *J. Ebersohn* E246, 8.ix.1962 (BRI); Camooweal, *P.K. Latz* 1597, 22.vii.1971 (NT); 20 miles S of Burketown, *W. MacGillivray* 2163, 31.vii.1928 (BRI); Cloncurry, *E. Palmer* 4B, 29.vii.1882 (BRI).

WESTERN AUSTRALIA: Marillana, *J.S. Beard* 4504, 12.viii.1966 (PERTH); 20 miles N of Millstream (Stn), *J.S. Beard* 4548, 18.vii.1966 (PERTH); between Dampier and Mt Tom Price, *J.G. Campion s.n.*, -x.1968 (PERTH); Fortescue R., *H.S. Carey s.n.*, 1878 (NSW); between Ashburton and De Grey Rivers, *E. Clement s.n.*, undated (1897) (K, holotype); Mary R., *W.V. Fitzgerald* 480, -xi.1905 (PERTH); Cane and Ashburton Rivers, *A. Forrest s.n.*, 1878 (MEL); Gascoyne R., *Pollack s.n.*, 1882 (MEL); between Dampier and Mt Tom Price, *E.B.J. Smith s.n.*, -x.1968 (PERTH); Ord River (Stn), *P. Walter s.n.*, 31.v.1960 (DNA).

Notes

Field data from the Northern Territory and Queensland suggests that this species is mainly restricted to heavy clay soils.

5. *Streptoglossa tenuiflora* Dunlop; species nova, affinis *S. liatroidi* (Turcz.) Dunlop et *S. adscendii* (Benth.) Dunlop, a quibus receptaculo eglanduloso et flosculis perangustis differt.

Herba annua (? perennis). Rami et folia pilosa usque villosa, glandulifera, glandulis brevissimis stipitatis; *Caulis* erectus, ramificatione diffusus. *Folia* inferiora anguste obovata, irregulariter serrata, 2.5-4 cm longa, 0.3-0.8 cm lata, costa decurrente; folia superiora anguste obovata usque linearia, 0.6-2.5 cm longa, 0.05-0.3 cm lata, cum pluribus foliis linearibus villosis sub capitulis. *Capitula* in extremitatibus ramorum brevium vel longorum, in corymbis laxis disposita; flosculi c. 90, plures marginales quam disci. *Receptaculum* glabrum, eglandulosum, foveolatum. *Involucri* c. 1 cm longa. *Phyllaria* extima cuspidata, ad apices glabra, sub apicibus glandulosa, pilosa et dense ciliata; phyllaria mediana cuspidata usque acuminata, glabra vel glabrata; phyllaria intima angusta, acuta, apicibus plumosis. *Flosculi marginales* ligulati; ligulae extra glanduliferae, 1-2 mm longae, 2-lobae, leviter ultra involucri exsertae. *Flosculi disci* c. 6 mm longi, 5- vel 4-lobi, lobis extra glanduliferis. *Achenia* c. 2 mm longa, sparse sericea, costis c. 8. *Pappus* uniserialis, setis c. 14 brevissime plumosis.

Holotypus: Western Australia, De Grey Stn, *N.T. Burbidge* 1584, 28.vii.1941 (PERTH). Fig. 1.

Annual (? perennial) *herb*; vegetative parts pilose to villous, glandular, glands very shortly stipitate, appearing sessile. *Stem* erect, diffusely branched. Lower *leaves* with decurrent midrib, oblanceolate, bases attenuate, 2.5-4 cm long, 0.3-0.8 cm wide, irregularly serrate; upper leaves oblanceolate to linear, 0.6-2.5 cm long, 0.05-0.3 cm wide, with several villous leaves under capitula. *Capitula* on short or long branches, in loose corymbs; florets c. 90, disc fewer than marginal. *Involucre* c. 1 cm long. Outer *phyllaries* cuspidate with glabrous tips, densely ciliate, pilose and glandular below the tip; median cuspidate to acuminate, glabrous or glabrescent; inner narrow acute with plumose tips. *Receptacle* foveolate, glabrous, non-glandular. *Marginal florets* ligulate, ligules 1-2 mm long, 2-lobed, glabrous, glandular. *Disc florets* c. 6 mm long, 5- or 4-lobed, lobes glandular. *Achenes* c. 2 mm long, sparsely sericeous, with c. 8 ribs. *Pappus* in a single series, setae c. 14, very shortly plumose.

Distribution

Western Australia. Map 3.

Specimens Examined

WESTERN AUSTRALIA: Pardoo Stn, Pardoo Flats, *N.T. Burbidge* 1521, 24.vii.1941 (PERTH); De Grey Stn, *N.T. Burbidge* 1584, 28.vii.1941 (PERTH, holotype).

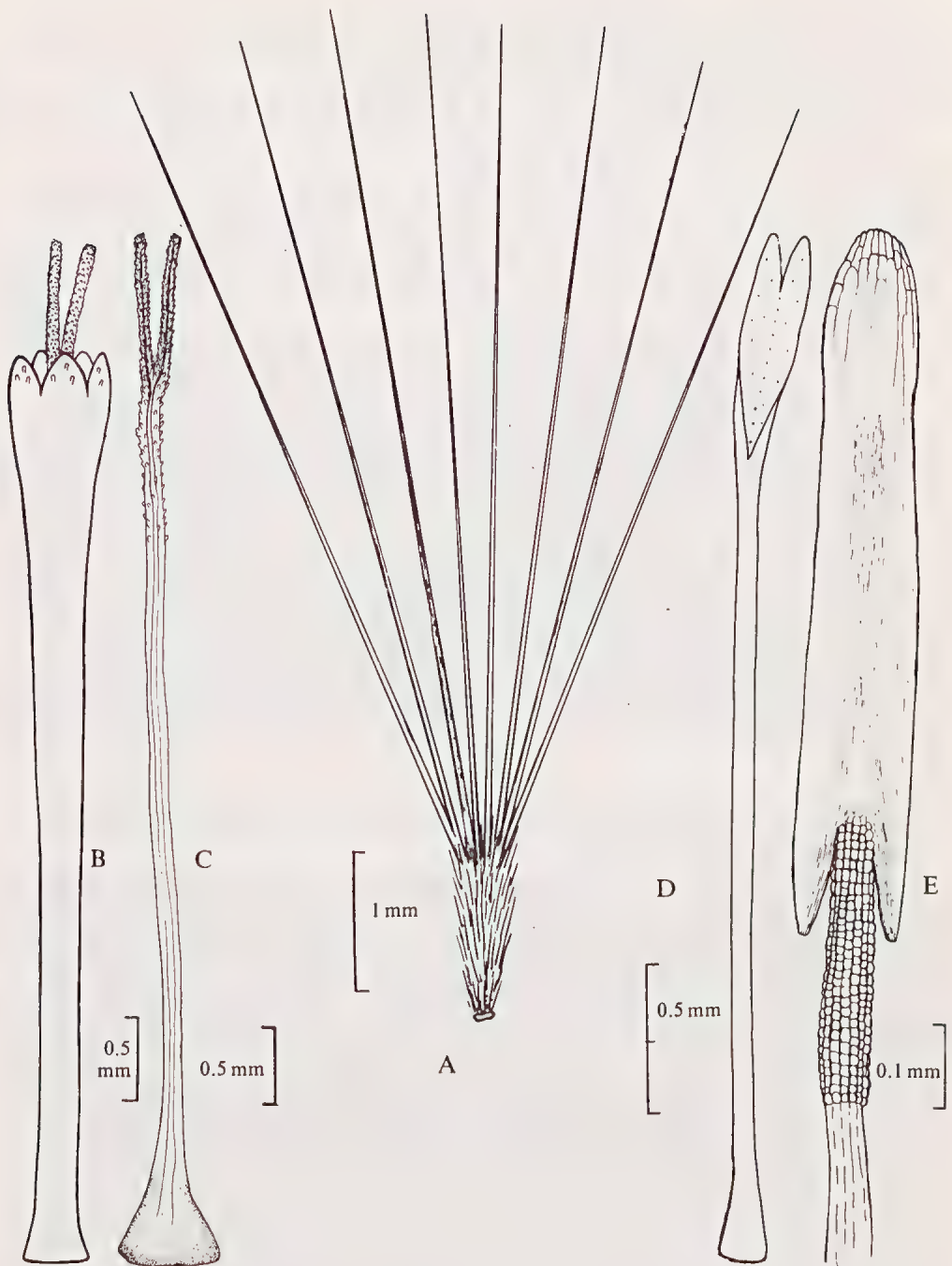


Fig. 1. *Streptoglossa tenuiflora* Dunlop, from holotype. A, achene; B, corolla of disc floret; C, style of disc floret; D, corolla of marginal floret; E, stamen.

6. *Streptoglossa liatroides* (Turcz.) Dunlop, comb. nov.

Erigeron liatroides Turcz., Bull. Soc. Imp. Nat. Moscow 24 (1): 172 (1851), *basionym*.

Type: Nova Hollandia (Western Australia), *J. Drummond* iv. 222, undated [KW (n.v.)], holotype, NT photo; MEL 42573; PERTH].

Pterigeron liatroides (Turcz.) Benth., Fl. Aust. 3: 532 (1867); Bailey, Qld Fl. 3: 819 (1900); Black, Fl. S. Aust. 4: 892 (1957).

Pluchea ligulata F. Muell., Rep. Babb. Exped. 12 (1859).

Type: L. Torrens (L. Gregory, Wonomulla Blanchwater), *G. Hawker* s.n., undated (1858) (MEL 42574, syntypes).

Pterigeron liatroides var. *humilis* Benth., Fl. Aust. 3: 532 (1867).

Type: the interior of Australia, *J. McD. Stuart* s.n., 1859 (K, syntype); L. Gregory, *G. Hawker* s.n., undated [K (n.v.)], syntype].

Pterigeron microglossus Benth., Fl. Aust. 3: 532 (1867), *nom. illeg.*, p.p. [*quoad specim.* Sturt Ck, *F. Mueller* s.n., undated (1856) (K, syntype; MEL 42586)]; Bailey, Qld Fl. 3: 820 (1900).

Pterigeron liatroides var. *repens* S. Moore, J. Linn. Soc. Bot. 34: 196 (1898).

Type: between Gibraltar and Coolgardie, *S. Moore* s.n., -x.1895 [BM (n.v.)], lectotype here designated, NT, photo]; between Uladdie soak and Yilgange claypans, *S. Moore* s.n., -iii.1895 [BM (n.v.)], NT, photo, syntype].

Short-lived perennial *herb* to c. 50 cm; vegetative parts not, or only slightly aromatic, pilose, glandular; glands very shortly stipitate, appearing sessile. *Stem* erect, ascending or prostrate, leafy. *Leaves* oblanceolate to spatulate, acute to obtuse, bases attenuate, 1-5 cm long, 0.2-1.5 cm wide, margins irregularly serrate or entire, several narrow leaves subtend capitula. *Capitula* on long branches; florets 50-190, disc fewer than marginal. *Involucre* 1.1-1.7 cm long. Outer and median *phyllaries* ciliate, glabrescent to villous, sparsely glandular; inner glabrous or glabrescent with plumose tips, non-glandular. *Receptacle* foveolate, glabrous, glandular. *Marginal florets* ligulate, ligules 3-6.7 mm long, 2-4-lobed, glabrous, glandular. Corollas of *disc florets* 6-9 mm long, 5-lobed, glabrous, glandular. *Achenes* 2.5-4 mm long, densely or sparsely sericeous; ribs 10-13. *Pappus* in c. 2 series.

Distribution

Northern Territory, New South Wales, South Australia, Western Australia. Map 3.

Selection of Specimens Examined

NORTHERN TERRITORY: 11 miles N of Maryvale Homestead, *G. M. Chippendale* NT 2737, 3.ix.1956 (NT); Mongrel Downs, *C. R. Dunlop* 1837, 5.viii.1970 (NT); Barrow Creek, *E. Gauba* s.n., 6.x.1950 (CBG, NSW); Charlotte Waters, *C. Giles* s.n., 1875 (MEL); Finke R., *H. Kempe* 240, undated (MEL); James Ra., *P. K. Latz* 4918, 23.iv.1974 (BRI, CANB, MO, NT); Sturt Ck, *F. Mueller* s.n., undated (1856) (MEL 42586; K, syntype of *Pterigeron microglossus*); between Crown Point and Horseshoe Bend, *S. A. White* s.n., -viii.1913 (AD).

NEW SOUTH WALES: Yandarloo (Yandaroo), *W. Bauerlen* 197, -ix.1887 (BRI); Koorningbirry (Koonenberry Mt.), *W. Bauerlen* 197, -ix.1887 (MEL); Milparinka to Tibooburra, *N. C. W. Beadle* s.n., -ix.1939 (NSW); Evelyn Ck, N of Barrier Ra., *A. King* s.n., 1887 (MEL).

SOUTH AUSTRALIA: L. Torrens (L. Gregory, Wonomulla), *Babbage* Exped. s.n., undated (1858) (MEL 42574, syntype of *Pluchea ligulata*); Anna Creek, *J. B. Cleland* s.n., 10.ix.1930 (AD); S Charlotte Water. *L. Dietrich* 8, 1885 (MEL); near Mt Everard, *E. Giles* s.n., 1882 (MEL); Dalhousie Springs, *T. Gill* s.n., -vi.1916 (NSW); Evelyn Downs, *E. H. Ising* s.n., -x.1950 (ADW); Mt Lyndhurst, *M. Koch* 257, 1897 (NSW); Mt Sarah, *T. R. N. Lothian* 1944, 13.viii.1963 [AD (n.v.)], NSW, NT], L. Eyre, *W. B. Spencer* s.n., -ix.1903 (NSW); interior of Australia, *J. McD. Stuart* s.n., 1859 (MEL).

WESTERN AUSTRALIA: Doorawarrah, *T. E. H. Aplin* 5385, 13.xi.1963 (PERTH); near Lyndon R., *H. S. Carey* s.n., 1885 (MEL, two sheets); Western Australia, *J. Drummond* iv. 222, undated [KW (n.v.)], holotype of *Erigeron liatroides*, NT photo; K (n.v.), MEL 42573, PERTH]; Western Australia, *J. Drummond* s.n., undated (MEL, seven sheets; NSW); Cane R., *A. Forrest* s.n., 1878 (MEL); Nannine, *W. V. Fitzgerald* s.n., -ix.1903 (NSW, includes *S. cylindriceps*; PERTH); Wandagee, *C. A. Gardner* 6200, 8.x.1941 (PERTH); between Uladdie Soak and Yilgange claypans, *S. Moore* s.n., -iii.1895 [BM (n.v.)], NT photo.]; between Gibraltar and Coolgardie, *S. Moore* s.n., -x.1895 [BM (n.v.)], NT photo.]; 40 miles SE of Gascoyne Junction, *B. L. Turner* 5385, 22.viii.1965 [MEL (n.v.); PERTH, voucher for chromosome count].

Notes

S. liatroides is a widespread and variable species. The capitula in plants from South Australia and southern Western Australia are generally larger than those from the northern limits of distribution but no discontinuity is apparent. The density of duplex hairs on the achene is also variable. Achenes from southern localities are usually more densely sericeous than those from the north. Bentham's *Pterigeron microglossus* is based partly on one of these northern forms with small capitula and sparsely hairy achenes.

In describing *Pluchea ligulata*, Mueller cited collections from several localities including Lake Gregory and Wonnomulla Blanchwater, naming G. Hawker as the collector. The only collection the author has seen which could possibly correspond to these is MEL 42574, labelled: "*Pluchea ligulata* . . . Babbage . . . Lake Torrens (Lake Gregory, Wanomulla)". The annotation is Mueller's so presumably this represents the type sheet.

A similar situation exists with *Pterigeron liatroides* var. *humilis*. Bentham cited "In the interior, Lake Gregory, G. Hawker; Strangways River, McDouall Stuart's Expedition" with his original description though specimens labelled as such have not been seen. A Stuart collection of *P. liatroides* var. *humilis* which probably corresponds to the above has been annotated by Bentham with volume and page reference to Flora Australiensis. The label does not mention Strangways R., giving the locality merely as 'the interior of Australia'.

Stuart's specimen consists of a sheet of stunted plants which have flowered prematurely, undoubtedly as a result of a short growing season. In all other respects these plants are within the normal range of variation of the species.

In the extreme form, *P. liatroides* var. *repens* S. Moore would appear to be a distinct taxon. The type specimens and others from the Goldfields area of Western Australia are decidedly prostrate and have leaves of a regular size and shape over the whole plant. There is a large number of specimens, however, showing intermediate features between this variety and the type, presenting a continuum between the upright and prostrate forms.

Chromosome number

The chromosome number, $n = 10$, was reported for *S. liatroides* by Turner (1970).

7. *Streptoglossa adscendens* (Benth.) Dunlop, comb. nov.

Pterigeron adscendens Benth., Fl. Aust. 3:533 (1867), *basionym*. Bailey, Qld Fl. 3:820 (1900); Black, Fl. S. Aust. 4:893 (1957).

Type: Suttor R., *F. Mueller s.n.*, undated (1856) (K, lectotype here designated; MEL 42542); Cape R., *E. Bowman s.n.*, undated (K, syntype); Roper R., *F. Mueller s.n.*, undated (K, syntype, = *S. odora*); Flinders R., *F. Mueller s.n.*, undated (K, syntype); Belyando R., *T.L. Mitchell* [K (n.v.), syntype].

Annual or short-lived perennial herb to 40 cm; vegetative parts slightly aromatic, pilose, glandular; glands very shortly stipitate, appearing sessile. Stem erect, much branched, leafy, the plants compact. Leaves oblanceolate, rarely spatulate, acute, bases attenuate, 1-5 cm long, 0.1-1.7 cm wide, margins irregularly serrate or entire. Capitula on short, rarely long, branches, often almost sessile, scattered; florets 20-40, disc fewer than marginal. Involucre 0.7-1.1 cm long. Outer phyllaries with leaf-like tips, ciliate, pilose, glandular; median ciliate or entire, pilose or glabrescent, usually glandular; inner ciliate, non-glandular or sparsely so. Receptacle alveolate-fimbriate, glabrous, glandular. Marginal florets ligulate, ligules 1-2 mm long, glabrous, glandular. Corollas of disc florets 4-6 mm long, 5- or 4-lobed, glabrous, glandular. Achenes 2-3 mm long, densely sericeous, with 6-8 ribs. Pappus in 2 series.

Distribution

As for the genus. Map 1.

Selection of Specimens Examined

NORTHERN TERRITORY: 6 miles S of Alroy Downs, *G.M. Chippendale* NT 7344, 22.vi.1960 (AD, CBG, MEL, NSW, NT); Field R.; *C.R. Dunlop* 2580, 23.v.1972 (NT); Powells Ck, *W. Holtze* 134, 1894 (MEL); Finke R., *H. Kempe* s.n., 1889 (MEL); Birrindudu, *P.K. Latz* 4000, 18.vii.1973 [CANB, DNA, NT, PERTH (n.v.)]; 23 miles W of Mount Riddock H.S., *D.J. Nelson* 2222, 19.vii.1972 (NT); Charlotte Waters, *W. Schwartz* s.n., 1889 (MEL).

QUEENSLAND: Longreach, *J. Bancroft* s.n., -viii.1918 (BRI); Julia Creek, *S.T. Blake* 6335, 21.vi.1934 (BRI); Cape R., *E. Bowman* s.n., undated (K, syntype of *Pterigeron adscendens*); 28 miles E of Isisford, *S.L. Everist* 2980, 10.vi.1947 (BRI, CANB); subtropical New Holland, *T.L. Mitchell* 252, 2.viii.1846 (K); Suttor R., *F. Mueller* s.n., undated (K, syntype of *Pterigeron adscendens*; MEL 42542); Flinders R., *F. Mueller* s.n., undated (K, syntype of *Pterigeron adscendens*); Aramac, *C.T. White* s.n., -iii.1918 (BRI).

NEW SOUTH WALES: Mt Poole, *W. Bauerlen* 300, -x.1887 (MEL).

SOUTH AUSTRALIA: Frome R., *J.M. Black* s.n., 12.x.1917 (AD, three sheets); towards L. Eyre, *E. Giles* s.n., 1872 (MEL); Evelyn Downs, *E.H. Ising* s.n., 3.ix.1952 (ADW); Mt Lyndhurst, *C. Koch* 140, 1897 (MEL, NSW); Blanchewater, *R.H. Kuchel* 823, 21.viii.1963 (AD); L. Eyre, *W.B. Spencer* s.n., -ix.1903 (NSW); western edge Simpson Desert, *D.E. Symon* 3294, 14.ii.1965 [ADW, MSC, (n.v.)]; 80 km W of Oodnadatta, *S.A. White* s.n., 11.vii.1914 (AD).

WESTERN AUSTRALIA: 3.5 miles W of Mt Stuart, *H. Demarz* 2482, 20.viii.1970 (PERTH); W of Wiluna, *C.A. Gardner & W.E. Blackall* CAG 2385, undated (22.vii.1931) (PERTH, includes *S. liatroides*); Wandagee, *C.A. Gardner* 3238, 29.viii.1932 (PERTH); Gordon Downs, *L.J. Mulhearn* 286, 9.vii.1949 (NT).

Notes

Amongst the specimens annotated and cited by Bentham in describing *Pterigeron adscendens* is a specimen of Mueller's from Roper R. This is *S. odora*. Of the remaining four specimens, Mueller's specimen from Suttor R. was selected as the lectotype.

The preferred habitat of *S. adscendens* in the Northern Territory is the cracking clay plains of the Barkly Tablelands. It occurs in similar areas in western Queensland.

8. *Streptoglossa cylindriceps* (Black) Dunlop, comb. nov.

Pterigeron cylindriceps Black, Trans. R. Soc. S. Aust. 39:839 (1915), *basionym*.

Type: Moorilyanna Waterhole, *S.A. White* s.n., 7.vii.1914 (AD 97131197, lectotype here designated); 50 miles W of Oodnadatta, *S.A. White* 2, 1.vii.1914 (MEL 42547, syntype).

Annual or short-lived perennial *herb*; vegetative parts not aromatic (? slightly so), pilose, glandular; glands very shortly stipitate, appearing sessile. *Stem* prostrate, leafy. *Leaves* oblanceolate to spatulate or obovate, acute to obtuse, bases attenuate, 0.4-3.5 cm long, 0.1-2 cm wide, margins entire or regularly serrate. *Capitula* on long or short branches, towards or at the periphery of the plant; florets 35-80, disc fewer than marginal. *Involucre* 1.5-2.3 cm long. Outer *phyllaries* glabrous or glabrescent, non-glandular; median and inner glabrous, non-glandular. *Receptacle* alveolate-fimbriate, glabrous, non-glandular. Corollas of *disc florets* 7-9 mm long, 5- or 4-lobed, glabrous, glandular. *Achenes* curved, 3.5-5 mm long, sparsely sericeous; with 7-9 ribs. *Pappus* in a single series or with a few setae in a second series, recurved from below the middle on drying.

Distribution

Northern Territory, South Australia and Western Australia. Map 2.

Selection of Specimens Examined

NORTHERN TERRITORY: 1 mile NW of Central Mount Wedge Homestead, *G.M. Chippendale* NT 1838, 10.xi.1955 [AD (n.v.), BRI, NSW, NT]; Napperby, *C.R. Dunlop* 2462, 20.i.1972 (CBG, DNA, NSW, NT); Ayers Rock, *C.R. Dunlop* 2974, 31.viii.1972 (ADW, BRI, CANB, CBG, DNA, MEL, NSW, NT); Napperby,

T.S. Henshall 1209, 13.i.1976 (NT); Napperby, *P.K. Latz* 5950, 9.v.1975 (BRI, CANB, L, NT); c. 3 km N of Charlotte Waters, *E.A. Shaw* 469, 10.x.1966 (AD).

SOUTH AUSTRALIA: Alberga R., near Todmorden, *H.W. Andrew* s.n., 2.vii.1920 (AD); Muloorina, *R. Hill* 247, 25.vii.1955 (AD); Pedirka, *E.H. Ising* s.n., 26.viii.1932 (AD); 9 miles N of Warrina, *T.R.N. Lothian* 1367, 7.viii.1963 (AD); Diamantina R., *Morgan* s.n., 1931 (AD); Mt Parry, *N. Tate* s.n., -viii.1883 (AD, MEL); 50 miles W of Oodnadatta, *S.A. White* 2, 1.vii.1914 (MEL 42547, syntype of *Pterigeron cylindriceps*); Moorilyanna Water-hole, *S.A. White* s.n., 7.vii.1914 (AD 97131197, syntype of *Pterigeron cylindriceps*); Bloods Ck, *S.A. White* s.n., 20.vii.1921 (AD).

WESTERN AUSTRALIA: Wiluna, *T.E.H. Aplin* 2424, 21.viii.1963 (NT, PERTH); NE of Mullewa, *A.M. Ashby* 2552, 17.viii.1968 (BRI); Yandal, *W.E. Blackall* s.n., -ix.1939 (PERTH); Glenom, *N.T. Burbidge* 176, 18.vii.1938 (PERTH); 20 miles S of Mundiwindi, *N.T. Burbidge* 6059, 9.v.1958 (AD, CANB, PERTH); upper Swan R., *M. Eaton* s.n., 1883 (MEL, includes *S. liatroides*); Nannine, *W.V. Fitzgerald* s.n., -ix.1903 (NSW, includes *S. liatroides*); 10 miles S of Mt Magnet, *A.S. George* 907, 21.viii.1960 (PERTH); between Yuin and Murchison Rivers, (*E. Giles* s.n., undated (1876) (MEL); Port Hedland area, *B. Runich* s.n., undated (PERTH); 2 miles E of Windidda stockyards, *N.H. Speck* 1256, 20.viii.1958 (CANB, PERTH); Mt Narryer, *I. Tyson* 32, 1893 (MEL); upper Murchison R., *H. & J. Walsh* 13, 1894 (MEL); Bebele Junction, *D.G. Wilcox* 28, 31.iii.1952 (PERTH); Bilgarrie, Cutarrie Bore, *P.G. Wilson* 7410, 28.vii.1968 (PERTH).

Notes

Black cited two specimens when describing *Pterigeron cylindriceps*. One only of these specimens is held at AD and it is this specimen which is chosen as the lectotype.

In the original description, Black describes this species as erect. The author's experience and field notes on herbarium labels suggest, however, that it is prostrate. This habit distinguishes it from all the other taxa with the exception of a form of *S. liatroides* from Western Australia.

Excluded Species

1. *Pterigeron filifolius* (F. Muell.) Benth. = *Allopterigeron filifolius* (F. Muell.) Dunlop (1981).
2. *Pterigeron dentatifolius* F. Muell. = *Dichromochlamys dentatifolia* (F. Muell.) Dunlop (1980).

Acknowledgements

I am grateful to the Directors and staff of the following herbaria for the loan of specimens, for photographs of type specimens and in some cases for the use of facilities during short visits: AD, ADW, BM, BRI, CANB, CBG, K, KW, MEL, NSW, P. PERTH.

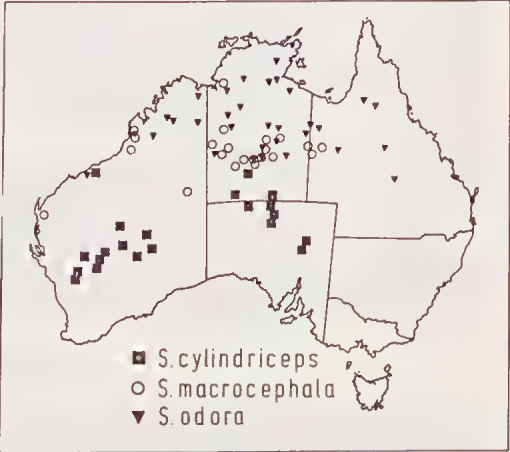
I am especially indebted to Dr Hj. Eichler, former Curator, Herbarium Australiense, for advice on nomenclatural matters and for valuable comments on an early draft manuscript.

My thanks are also due to Mr H.K. Airy Shaw, Royal Botanic Gardens, Kew, for checking and correcting the Latin description; to Miss Helen Aston, Melbourne, for information on the Henne collections; to J.R. Maconochie and P.K. Latz, Department of Primary Production, Alice Springs, for advice and encouragement during the course of the work; to Dr J.P. Jessop of the State Herbarium, South Australia, for his comments on the manuscript and to my wife Adrienne for the illustrations.

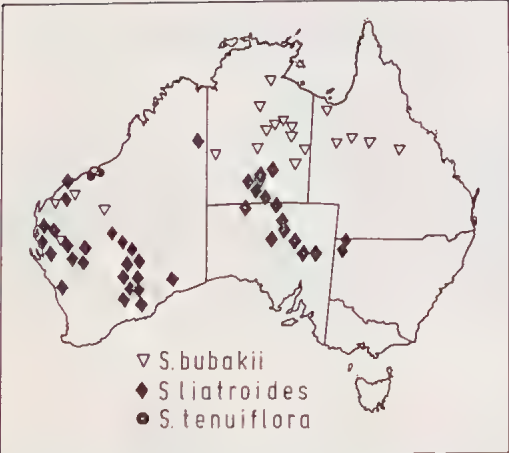
Costs of publication of this paper were met by the Northern Territory Government.



Map 1. Distribution of *Streptoglossa adscendens* and *S. decurrens*.



Map 2. Distribution of *Streptoglossa macrocephala*, *S. odora* and *S. cylindriceps*.



Map 3. Distribution of *Streptoglossa bubakii*, *S. liatroides* and *S. tenuiflora*.

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In the following list the taxon to which each collection is referred is denoted by the initial letter of the species name as follows: a = *Streptoglossa adscendens*; b = *S. bubakii*; c = *S. cylindriceps*; d = *S. decurrens*; l = *S. liaioides*; m = *S. macrocephala*; o = *S. odora*; t = *S. tenuiflora*.

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ALLOPTERIGERON, A NEW GENUS IN ASTERACEAE (INULEAE)

C. R. Dunlop

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Abstract

Allopterigeron Dunlop, a new genus from Northern Australia, is described. The new combination, *Allopterigeron filifolius* (F. Muell.) Dunlop is made for its only species; a detailed description is given with locality records and illustrations.

Introduction

During the course of a revision of *Pterigeron* (DC.) Benth. (= *Streptoglossa* Steetz in F. Muell.) (Dunlop, 1981) it became evident that *P. filifolius* (F. Muell.) Benth. was not closely related to other members of the genus.

Pterigeron filifolius was originally described under *Pluchea* Less. (Mueller, 1859a) as the only member of sect. *Oliganthemum*. In the same year Mueller (1859b) described *Pluchea* sect. *Rhodanthemum* to accommodate the group of species which was later to form the genus *Pterigeron* (Bentham, 1867). Bentham incorrectly combined Mueller's two sections under *Pterigeron* on the superficial resemblance between the female florets.

ALLOPTERIGERON Dunlop

Allopterigeron Dunlop, gen. nov., *Streptoglossa* Steetz in F. Muell. affinis, a qua flosculis discis 3-partitis sterilibus et antheris ecaudatis differt.

Herba annua. *Folia* simplicia, caulina, alterna, sessilia. *Capitula* heterogama. *Phyllaria* multiseriata, imbricata. *Receptaculum* planum, epaleaceum. *Flosculi marginales* feminei, fertiles, ligulati. *Flosculi disci* bisexuales fungentes masculi, stigmatibus integro; corollae 3-lobatae, antherae sine caudis. *Achenia* teretia, leviter complanata. *Pappus* persistens, plumosus-setosus.

Typus: *A. filifolius* (F. Muell.) Dunlop.

Annual herb. Leaves simple, cauline, alternate, sessile. Capitula heterogamous. Phyllaries in several series, imbricate. Receptacle flat, epaleaceous. Marginal florets female, fertile, ligulate. Disc florets bisexual, functionally male with entire stigmas; corollas 3-lobed; stamens 3, anthers without tails. Achenes terete, slightly flattened. Pappus persistent, plumose-setose.

Only one species is included in this genus.

Allopterigeron filifolius (F. Muell.) Dunlop, comb. nov.

Pluchea filifolia F. Muell., Trans. Philos. Instit. Victoria 3: 56 (1859), *basionym*.

Type: Arnhem Land, salsola plains of the Roper R., F. Mueller s.n., 19.vii.1856 (MEL 42559, holotype).

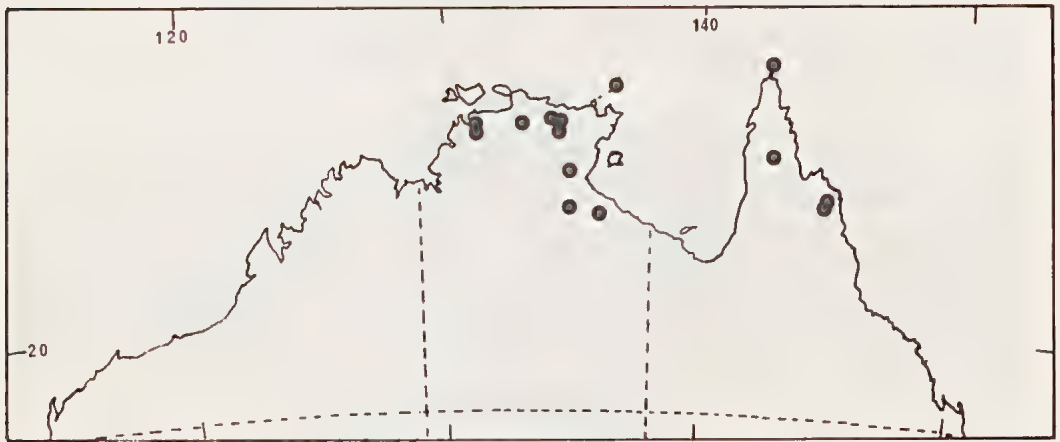
Pterigeron filifolius (F. Muell.) Benth., Fl. Aust. 3: 533 (1867).

Annual herb to 40 cm high; stems and leaves sparsely hairy and glandular; trichomes multiseptate, usually appressed to the stem, occasionally greatly elongated; glands minute, stipitate. Stems erect, diffusely branched. Leaves filiform, slightly fleshy, the margins recurved, 2-45 mm long, c. 0.6 mm wide. Capitula terminating short lateral branches, scattered; florets 4-7. Outermost phyllaries inserted c. 2 mm below the receptacle on the peduncle, the inner ones subtending the outer florets; narrow lanceolate, acuminate, smooth, glabrous with minute glands occasionally present; inner phyllaries

c. 10 mm long, outermost c. 1 mm long, recurved at maturity, never wholly reflexed. *Receptacle* irregularly sculptured, glabrous c. 0.8 mm broad, scarcely broader than the peduncle. *Marginal florets* 3-5, c. 5 mm long; ligules white, c. 1 mm long, minutely 2-lobed; style base bulbous. *Disc florets* 2-3, ovary vestigial; pappus absent; style strongly papillate; corolla tube white, c. 5 mm long, sparsely glandular; anthers c. 1 mm long. *Achenes* c. 2 mm long, closely ribbed, constricted below the pappus; sericeous with duplex hairs; carpopodium oblique. *Pappus* setae in several series, uneven. Fig. 1.

Distribution

Northern Territory and Queensland. Map 1.



Map 1. Distribution of *Allopterigeron filifolius* (F. Muell.) Dunlop.

Specimens Examined

NORTHERN TERRITORY: McArthur R. area, *L.A. Craven* 4112, 4.vi.1976 (CANB); Darwin, *C.R. Dunlop* 4468, 20.iv.1977 (DNA); Deaf Adder Gorge, *C.R. Dunlop* 4990, 18.vii.1978 (DNA); Arnhem Land, *P.K. Latz* 2976, 24.vi.1972 (BRI, L, NT); Arnhem Land, *P.K. Latz* 2987, 25.vi.1972 (CANB, DNA, NT); Arnhem Land, *P.K. Latz* 3024, 27.vi.1972 (NT); Wessel Island, *P.K. Latz* 3377, 1.x.1972 (DNA, NT); Darwin, *P.K. Latz* 3605, 28.iv.1973 (BRI, CANB, DNA, K, NSW, NT); Cox R., *P.K. Latz* 7307, 3.viii.1977 (DNA, NT); Arnhem Land, *F. Mueller s.n.*, 19.vii.1856 (MEL, holotype); 14 miles W of Liverpool R. crossing, *J. Must* 1066, 27.vi.1972 [CANB, DNA, K (n.v.), L. (n.v.), NSW (n.v.), NT]; Berry Springs, *M.O. Rankin* 1218, 27.v.1978 (CANB, DNA); 250 km ENE of Darwin, *R. Story* 8357, 16.vi.1978 (CANB, DNA).

QUEENSLAND: Thursday Is., *F.M. Bailey s.n.*, -vi.1897 (BRI); New Holland (prob. Endeavour R.), *Banks & Solander s.n.*, 1770 (NSW); Cape York Peninsula, *L.J. Brass* 19714, 27.vii.1948 (CANB); 15°45'S, 144°39'E, *N. Byrnes* 3090, 27.vii.1974 (BRI, DNA).

Notes

Pappus bristles were not seen on any of the sterile disc florets although Mueller (1859a) described them as occasionally having one or two bristles. The ovary of these florets is so reduced that the only evidence of its existence is a slight colour change at the base of the corolla and a few minute duplex hairs (Fig. 1).

Affinities

The most distinctive feature exhibited by *Allopterigeron* and that which separates it from all of the apparently closely related genera is the extreme reduction in the disc florets. Besides being few in number (2 or 3), the disc florets are three-partite and sterile with an entire stigma. They also lack a pappus and the anthers are without tails. The absence of anther tails is not unknown in the Inuleae (Merxmüller *et al.*, 1977; Randeria, 1960) and it is there that *Allopterigeron* is best placed with what Merxmüller *et al.*, have

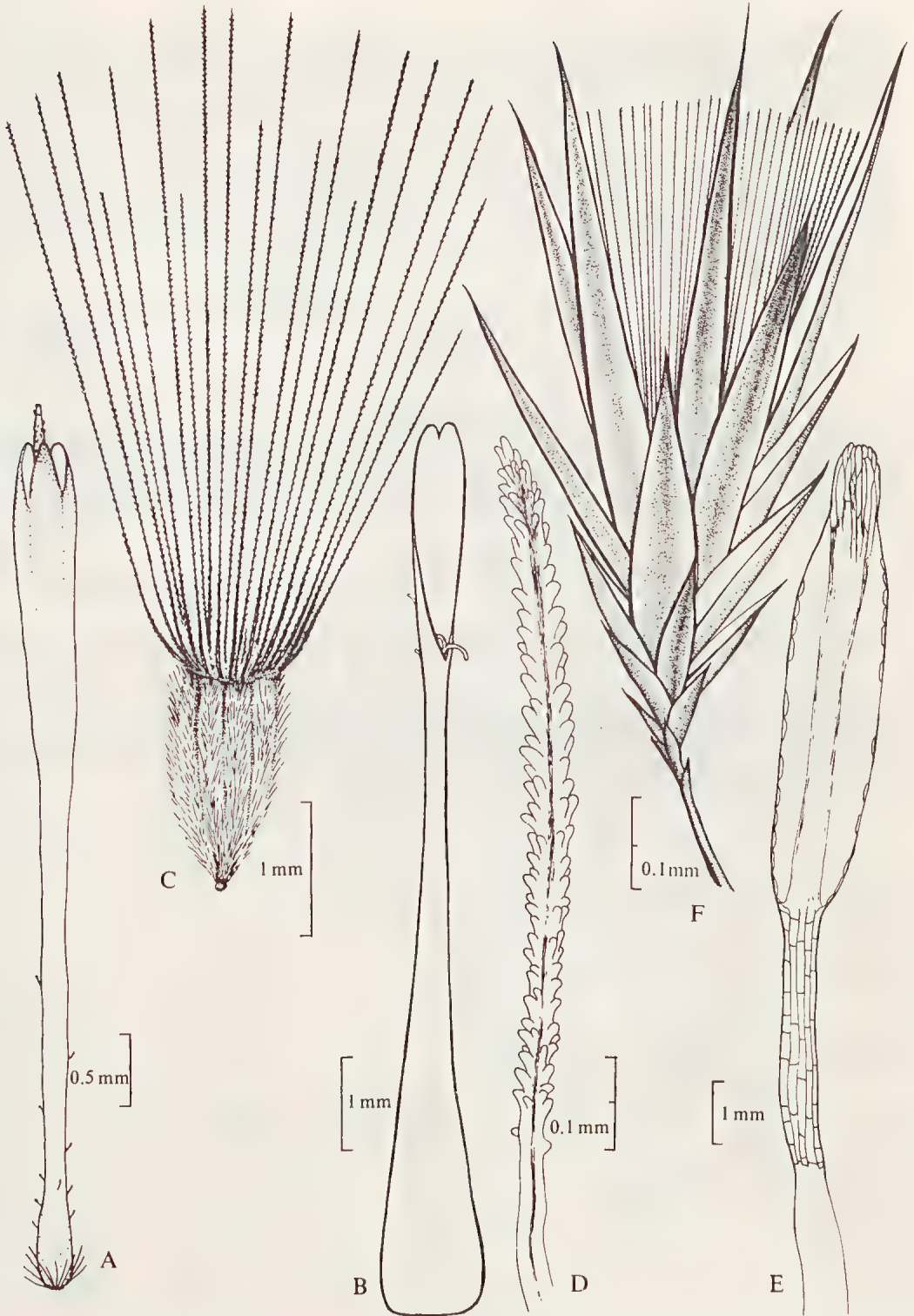


Fig. 1. A-F *Allopterigeron filifolius* (F. Muell.) Dunlop, from Dunlop 4990. A, disc floret; B, corolla of marginal floret; C, achene; D, style of disc floret; E, stamen; F, capitulum.

defined as the *Pluchea* group within the Inulinae. Of the eighteen genera listed for the group *Allopterigeron* appears to be closest to *Pterigeron* (= *Streptoglossa* Steetz in F. Muell.) where it was placed by Benthams (1867). Both genera possess ligulate female florets and have achenes of similar size, shape, vestiture and form of pappus. The achenes of *Allopterigeron* also have the superficial ribs seen in a number of species of *Streptoglossa* (Dunlop, 1981). Beside the severe reduction in the disc florets mentioned above, *Allopterigeron* may be distinguished from *Streptoglossa* by the structure of the involucre. In *Allopterigeron* the bracts of the involucre extend well down the peduncle with only the inner-most series subtending the diminutive receptacle. The involucre of *Streptoglossa* is inserted around and beneath the broad receptacle.

The main differences between these genera are summarised in the following key:

Florets few (c. 6); disc florets sterile, 3-partite; anthers tailless *Allopterigeron*
 Florets numerous (15-190); disc florets fertile, 4-, 5-partite; anthers tailed *Streptoglossa*

Acknowledgements

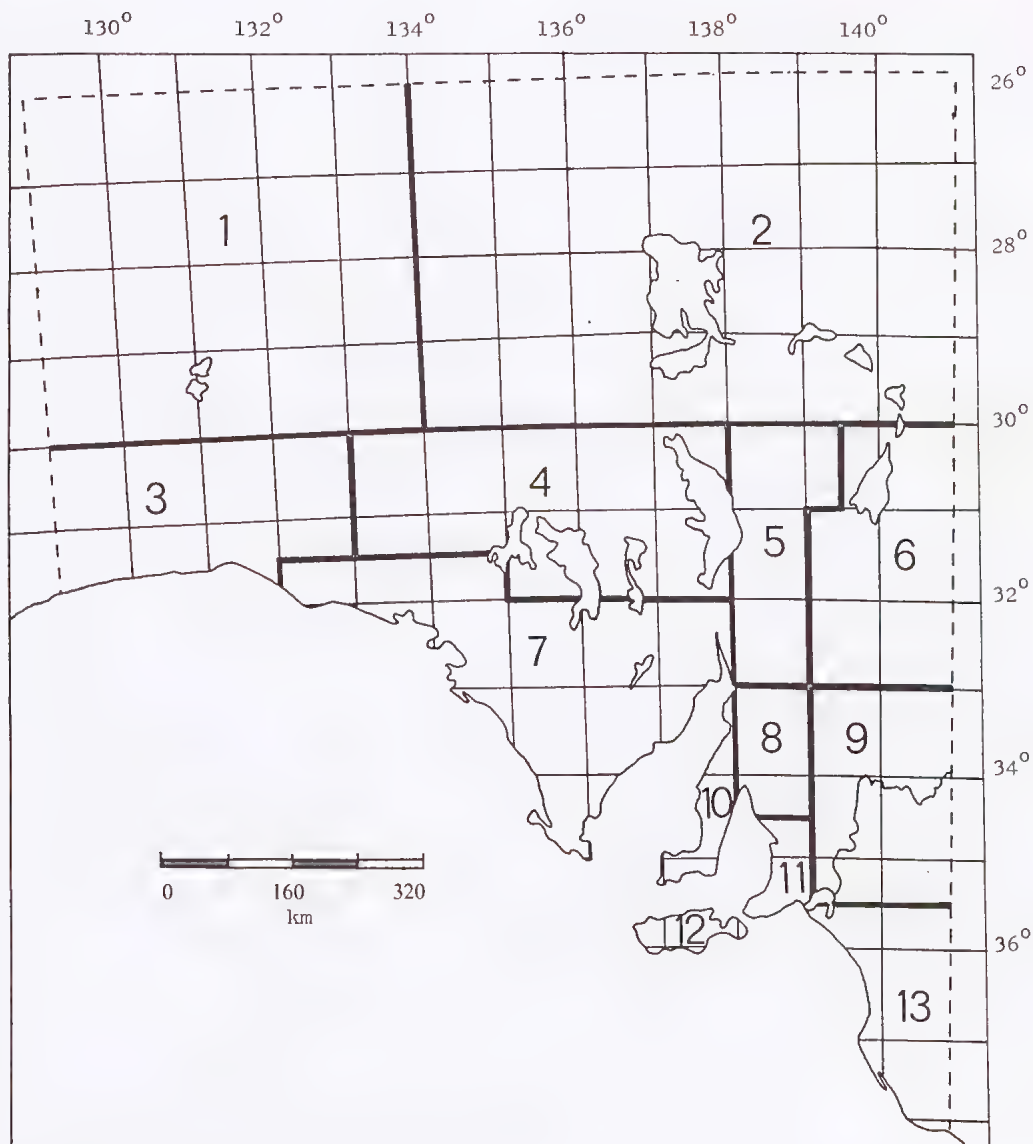
I am grateful to Dr Hj. Eichler, Curator, Herbarium Australiense, Canberra who kindly read an early draft of the manuscript and made several helpful suggestions. The help of my wife, Adrienne, in providing the illustrations is also gratefully acknowledged.

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REGIONS OF SOUTH AUSTRALIA ADOPTED BY THE STATE HERBARIUM — ADELAIDE

- | | |
|---------------------------|---------------------|
| 1. North-western | 8. Northern Lofty |
| 2. Lake Eyre Basin | 9. Murray |
| 3. Nullarbor | 10. Yorke Peninsula |
| 4. Gairdner-Torrens Basin | 11. Southern Lofty |
| 5. Flinders Ranges | 12. Kangaroo Island |
| 6. Eastern | 13. South-eastern |
| 7. Eyre Peninsula | |

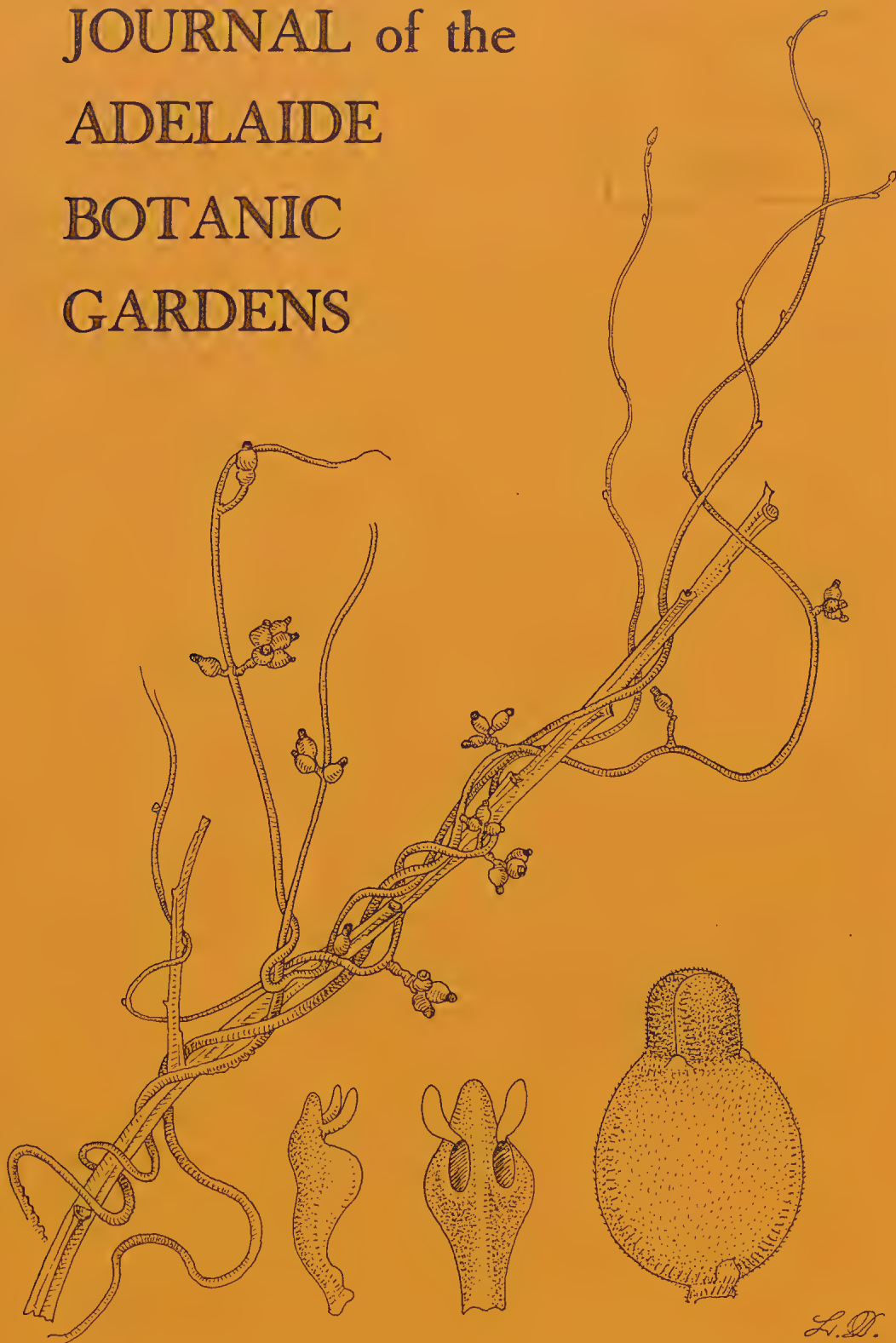


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A TAXONOMIC REVISION OF *CASSYTHA* (LAURACEAE) IN AUSTRALIA

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Abstract

The taxonomy of the genus *Cassytha* L. (Lauraceae) in Australia is revised: in Australia there are 14 species, 3 varieties and 5 forms, all of them endemic except *C. filiformis*, *C. capillaris* and *C. pubescens*. The following new taxa are described: *Cassytha aurea*, *C. pedicellosa*, *C. peninsularis*, *C. rufa*, *C. aurea* var. *candida*, *C. aurea* var. *hirta*, *C. peninsularis* var. *flindersii* and *C. glabella* f. *bicallosa*.

New combinations are: *Cassytha glabella* f. *casuarinae* (Nees) J.Z. Weber (*C. casuarinae* Nees), *C. glabella* f. *dispar* (Schltdl.) J.Z. Weber (*C. dispar* Schltdl.), *C. racemosa* f. *muelleri* (Meisn.) J.Z. Weber (*C. muelleri* Meisn.), *C. racemosa* f. *pilosa* (Benth.) J.Z. Weber (*C. racemosa* var. *pilosa* Benth.).

An introduction includes discussion of morphology and includes the first chromosome count for a species of *Cassytha* (*C. pubescens*: $n = 24$).

The affinities of the species are discussed, their distribution described, a key to the species, varieties and forms provided and a revised description of each taxon is supplemented with drawings, distributions maps and comment on possible evolutionary trends.

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Introduction

Species of *Cassytha* share a remarkable similarity of morphology and habit with *Cuscuta* (Convolvulaceae), but considerable differences in flower, fruit, physiological and anatomical features show that this similarity is only a case of convergent evolution to a parasitic habit. There is a notable uniformity in morphology throughout the genus *Cassytha* and the number of distinct species in the world is small (1, 2 or 3), except in Australia where fourteen species occur.

The major systematic treatment of *Cassytha* on a world wide basis was by Meisner (1864), dealing with 29 species; Bentham (1870) revised Australian *Cassytha* and recognized 11 species. Since Bentham only two new species and two varieties have been described for Australia although numerous collections have been made throughout the country. Later floras dealt with only part of the area, e.g. Blackall & Grieve (1954) eight species from Western Australia; Beadle (1972) six from north-eastern New South Wales; Willis (1972) five from Victoria; Beadle, Evans & Carolin (1972) four from the Sydney Region and Black (1948) three from South Australia. Old keys and descriptions are inadequate for a number of species occurring in Australia and a new approach was needed to reassess the taxa.

In the introductory historical review, references to type descriptions of species described outside Australia are fully cited as I have seen only the relevant parts and not the entire publications in which these taxa were described. I have not dealt with these non-Australian taxa in full, have not seen most of the types and have accepted the published views of other authors. For Australian species full references are provided as I have seen all the relevant publications. All specimens cited have been examined.

Brief History of Taxonomy of *Cassytha*

Linnaeus (1753, p. 35) first validated *Cassytha* as a generic name, which had been previously proposed in letters written by Osbeck from China. Linnaeus placed the genus and a single species (*C. filiformis*) in his Triandria Monogynia, although this species has 6 or 9 but never only 3 fertile anthers and *Laurus*, to which it has subsequently been shown to be closely related, has 9 stamens and was correctly placed in the Enneandria Monogynia.

N.L. Burman in 'Fl. Ind.' 93, t. 23, f. 1 (1768) described a new "*Cassytha*" from Java, placing it in the group of "Enneandria Monogynia". The specimen was described as having a woody stem, with a curved, horn-like appendage at each node and linear-lanceolate leaflets. Linnaeus (1771, p. 237) cited Burman's "*C. corniculata*" with *Laurus culilaban* presumably not seeing a specimen of the former. Nees (1866, p. 649) also listed *C. corniculata*, mistakenly attributed to Linnaeus, but listed it as being a dubious specimen. Eventually, Meisner (1864, p. 258) excluded it from the Lauraceae, and Kostermans in 'J. Sci. Res. Indon.' 1: 85, 94 (1952) recognized it as belonging to the Cactaceae.

Eleven years later "*Cassytha baccifera*" was described from India by Solander ex Miller in 'Illustratio Systematis Sexualis Linnaei', in Classis IX. Ordo I (1777) followed by the plate with the same enumeration and title. The description and drawing do not match the features of *Cassytha*, clearly showing trilobate anthers. Rumphel in Forster, 'Handb. Cacteenk.' 458 (1846) redetermined it as being *Cactus pendulus*.

From Sri Lanka, *C. zeylanica* was described by J. Gaertner in 'Fructus' 1: 134 (1788) but later included by Kostermans (1950, p. 85) in the synonymy of *C. filiformis*.

Jussieu (1789, p. 80) was first to describe the family Lauraceae ("Ordo VI. Lauri"), appending *Cassytha* to the list of genera on the basis of affinities in floral characters but drawing attention to its very different habit, resembling more closely that of *Cuscuta* (Convolvulaceae).

From Africa, Thunberg in 'Prod. Pl. Cap.' 78 (1794) described "*C. filiformis*" nom. illeg., which was put by Nees (1836, p. 645) in the synonymy of *C. glabella* R.Br. However, the present author believes that *C. glabella* is an exclusively Australian species, and the two collections in the Thunberg Herbarium [UPS (9847 & 9848)], seen only on microfiche, may belong to *C. ciliolata* Nees.

From Arabia, *C. aphylla* was described by Raeuschel in 'Nom. Bot.' ed. 3: 116 (1797) but it was put by Kostermans (1950, p. 85) in synonymy with *C. filiformis* L.

Ventenat (1799, pp. 245, 246), in dealing with the Order "Les Laurinees, Laurinae", includes the genus *Laurus*, but *Cassytha* received no mention.

From America, Miller ex Swartz in 'Fl. Ind. Occ.' 2: 876 (1800) described *C. polysperma*, which was placed by Kunth, in 'Feddes Rep. Beih.' 43: 314 (1928), in synonymy with *C. americana* Nees (the latter being treated by most authors, for example Stapf (1912) and Kostermans (1950), as *C. filiformis* L.).

Later, Brown (1810, p. 401) adopted the order name LAURINAE which he attributed to Ventenat, with Jussieu's Lauri as a synonym. Here he placed four genera, including

Cassytha with four newly described species from Australia. The descriptions were based mainly on his collections made from 8.xii.1801 to mid-1805.

From "Danish Guinea" (Ghana) *C. pubescens* was described by Schumacher ex Hornemann in 'De Indole Pl. Guineensis Observ.' 13 (1819) nom. nud. et illeg., but Junghans in 'Botan. Tidsk.' 57: 340 (1962) states "The MS confirms that the epithets, "*guineensis*" (1827) and "*pubescens*" are based on the same material". (See comment below on *C. guineensis* (1827)).

Nees in Wallich (1831, pp. 58-76), dealing with the "Order Laurinae" sensu Jussieu, listed 20 genera; *Cassytha* was included with 10 other genera in the group having fertile stamens of the fourth (innermost) whorl with unilocular anthers. In the meantime, Bartling (1830, p. 112) discussed the difference in habit of *Cassytha* from other genera in the Laurinae, but retained it there.

From Africa, Schumacher in 'Beskr. Pl.' 199 (299) (1827), described *C. guineensis*, which Stapf (1913, p. 188) placed in synonymy with *C. filiformis* L.

Subsequently, Lindley (1833, p. 112) segregated the Cassytheae from the Laurinae as leafless, herbaceous and tasteless (non-aromatic); incorrectly ascribing the former name to Bartling. This has been accepted later as the type description of the family Cassythaceae, the suffix being corrected to conform with the requirements of the International Code of Botanical Nomenclature. The name Cassythaceae Bartl. ex Lindl. has since been conserved.

In the same year as Lindley, Nees (1833, pp. 19-20) published his arrangement of the "Order Laurales" (footnote, p. 20), dividing it into two tribes, and the tribe "Laureae" into three groups, the last of these being the "Cassytheae". Three years later, in his monograph on the Laurales (1836, pp. 1-720) Nees subdivided the Lauraceae into thirteen tribes with 34 genera, where *Cassytha* was treated in "Tribus XIII. Cassyteae". In the treatment nine species were listed, one new one being described from America, one new species from South Africa and a new variety of *C. filiformis* (which received no name) from Java and Malaya.

Later Endlicher (1836, pp. 258 & 315) accepted the division by Nees (1836) but described the location of "Tribe XIII. Cassyteae" in "Laurineae" as dubious and bad.

Lindley (1836, p. 202) described the family Cassythaceae as distinct from the family Lauraceae, drawing his conclusion from data provided by Nees (1833), saying "There are distinctions enough even in the fructification to define Cassythaceae as a peculiar order" and he considered that *Cassytha* has "The general structure of Lauraceae, but: the stem dodder-like, parastitital, leafless". In his later publication on *Cassytha* (1846, pp. 535-538) he retained it next to the "Order CCV. Lauraceae,—Laurales" but still as a separate order "CCVI, Cassythaceae".

Shortly before, Meisner (1841, 324, Comm., p. 237) had included in the Order Laurinae 2 suborders, one being the monogeneric Cassyteae, the other the Laureae with 12 tribes and 31 genera.

From Africa four *Cassytha* species were recorded by E. Meyer in Drege, 'Zwei Pfl. Docum.' (1844), as follows: *C. glabella*, *C. triflora*, *C. rubiginosa* and *C. pubescens* all without authorities and nom. nud. On p. 171 they were listed alphabetically with authorities but again without description. Stapf (1912, p. 501-502) placed *C. glabella* sensu E. Meyer (not R. Br.) and *C. triflora* E. Meyer under synonymy of *C. ciliolata* Nees, put *C. pubescens* sensu E. Meyer (not R. Br.) and *C. rubiginosa* E. Meyer in synonymy with *C. pondoensis* Engl.

Nees in Lehmann (1845, pp. 619-622), attributed authorship of the order "Laurineae" to Endlicher, as well as of the "Tribe XIII. Cassyteae"; and of the suborder "I. Cassyteae"

to Meisner. Here were described seven new species of *Cassytha* from Western Australia, based on the collections of L. Preiss, made between 1838-1840. He placed them in two groups having the perianth urceolate or rotate, a view with which Bentham (1870) "could not concur".

Two years later Schlechtendahl in 'Linnaea' 20 (5): 577 (1847) described from Australia a new species, *C. pubescens* and, on p. 578, another, *C. dispar*. One year later, again in 'Linnaea' 21: 444, he renamed *C. pubescens* (non. R. Br.) as *C. piligera* Schldtl., which was subsequently put by Bentham (1870) into synonymy of *C. pubescens* R. Br., where I have retained it. *C. dispar* was put by Bentham (1870) in synonymy with *C. glabella* R. Br., but I have made it a form of *C. glabella*.

The second contribution by Meisner appeared in De Candolle (1864, pp. 1-260), where the "Order" Lauraceae was divided into three suborders: suborder 2 Gyrocarpeae, which is now in the family Hernandiaceae; suborder 1 Laurineae; and the monogeneric suborder 3 Cassytheae. Kostermans (1957, p. 220) regards these last two as sub-families. Although Meisner combined several of Nees' genera, he still accepted four tribes with 46 genera. Each tribe was accompanied by a diagnosis. In the treatment of *Cassytha* (pp. 252-258), he dealt with 29 species, fourteen of them and seven varieties being newly described. From Australia 25 species and one variety were recognized; twelve species and one variety were new. The genus was subdivided according to the inflorescence being capitate, spicate, racemose or umbellate, each taxon being provided with a description. The diagnoses of Australian taxa were based mainly on specimens from Hooker's Herbarium, to a lesser extent on those in Boissier's and on the collections of De Candolle, Drummond, Gunn, Harvey, Mueller and Sieber. There is no evidence that he saw R. Brown's original herbarium which was, at that time, in Bennett's care at the British Museum.

Two years later Mueller (1866, p. 167) dealt with seven genera in the "Laurinae", one of them being *Cassytha*, which was represented by five species and a new variety; the variety, *C. paniculata* var. *phaeolasia*, was four years later raised to species rank by Bentham.

Bentham (1870, pp. 293-315) provided a comprehensive account of the known Australian Order "Laurineae". He also established three suborders which differ from Meisner's; "Laureae" with six genera, the monogeneric "Cassytheae" with *Cassytha* and "Hernandieae" now in the family Hernandiaceae. A key was provided to suborders and genera, as well as a separate key to the species. In his treatment of *Cassytha* in Australia he recognized 11 species and three varieties; two varieties were newly described. Eight of Meisner's species were reduced to synonymy, one being retained as a variety and one listed as a dubious species.

Three of Nees' and two of Schlechtendahl's species were also included in synonymy. Mueller's variety was raised to species rank. For distinguishing species the characters used in the key were type of inflorescence, indumentum and stamens. He recognised the difficulties in the identification of some species before the fruits mature and pointed out the error of Meisner and Nees in describing different forms as distinct species. In the discussion on Lindley's proposal to place *Cassytha* in a distinct natural order he stressed (p. 308) "The structure of the flower is so precisely that of *Cryptocarya*, that it has been reunited with Laurinae". Bentham in Bentham & Hooker (1880) employed the same classification except that he termed the subdivisions "tribes" and not suborders.

From Central America, *C. dissitiflora* was described by Meisner, 'Kjoeb. Vidensk. Meddel.' 145 (1870), but it was later placed by Kostermans (1950, p. 85) in synonymy with *C. filiformis* L.

From the Philippines *C. capillaris* was described by Fernandes-Villar, 'Nov. App.' 182

(1880), a nom. illegit. and reduced to synonymy by Merrill, 'Enum. Philip. Fl. Pl.' 2: 204 (1923), under *C. filiformis* L.

Tepper (1888) described *C. tepperana* from Kangaroo Island (South Australia); I have placed it in synonymy with *C. pubescens* R. Br.

Pax in Engler & Prantl (1889, p. 124) produced a general monograph where he based his classification of the Lauraceae on the number of stamens and anther cells. The Lauraceae was divided into two subfamilies, 1. Persoideae and 2. Lauroideae. The genus *Cassytha* was placed in the Lauroideae—Cassytheae along with four other subdivisions of the Lauroideae. Kostermans (1957, p. 221) mentioned that Dadswill & Eckersley (1940) and Desch (1941), accepted Pax's subdivision into Lauroideae and Persoideae.

From Africa *C. pondoensis* was described by Engler in 'Bot. Jahrb.' 26: 392 (1899). From Timor *C. timoriensis* was described by Gandoger in 'Bull. Soc. Bot. France' 60: 419 (1913) based on a collection made by Zippel (1865). I have seen the type collection and determined it as being *C. filiformis* L.

A new species from Australia *C. strigosa* was described by Fitzgerald in 'J. Roy. Soc. W. Austral.' 3: 143 (1918) based on his own collection made in 1913. I have put it in synonymy with *C. capillaris* Meisn. (1864).

For New Caledonia, "*Cassytha lifuensis*" and "*C. macrocarpa*" were described by Guillaumin in 'Bull. Soc. Bot. France' ser. 4 (24): 1103 (1924), but this is a typographic error and the generic name should read *Cryptocarya*.

Domin (1925, pp. 674-680) in his classification of Lauraceae, included *Cassytha* with four other genera and described for Australia a new variety *C. filiformis* var. *pseudo-pubescens* based on his collection from southern Queensland made in 1909-1910. However, I have reduced this variety to synonymy with *C. filiformis*.

From Africa, *C. senegalensis* was described by Chevalier, 'Fl. Viv. Afric. Occ. France'. 1: 46 (1938), but it was reduced to synonymy with *C. filiformis* L. by Hutchinson & Dalziel (1954).

From New Guinea, *C. archboldiana* and *C. tenuis* were described by Allen (1942, p. 155) based on collections made by Brass (1936-1938); I have put the former into synonymy with *C. filiformis* L. and the latter into synonymy with *C. capillaris* Meisn. (1864).

Another species *C. novo-guineensis*, was described from New Guinea by Kanehira and Hatushima in 'Bot. Mag. (Tokyo)' 57 (677): 190 (1943) based on their collection made in West Irian (1940). I have put it in synonymy with *C. filiformis* L.

From Africa, *C. schliebenii* was described by Robyns and Wilczek in 'Bull. Jard. Bot. Etat Bruxelles' 19: 506 (1949) based on a collection made by Schlieben in Tanganyika (1931).

Kostermans (1957a) revised the Lauraceae, describing two subfamilies, Lauroideae and Cassythoideae, the latter with a single genus. The characters used were principally whether arborescent with "normal" leaves or climbers without "proper" leaves. This classification was confirmed in his second publication (Kostermans, 1957b).

Within the Lauraceae, Sastri (1962) considered that "On embryological grounds there is not sufficient evidence to remove *Cassytha* to a separate family". Hutchinson (1964) retained *Cassytha* in the Lauraceae, in tribe 6. Cassytheae. Hegnauer (1966, p. 351), in his chemotaxonomic study in Lauraceae, produced a system rather similar to that of Pax (1889), placing the monogeneric subtribe Cassytheae in subfamily Lauroideae. Pax's system was regarded by Kostermans (1957) as very artificial.

During the period that has elapsed since the publication of the most comprehensive

treatment of the Australian Laurales (Bentham, 1870), most Australian systematists have treated *Cassytha* as a genus within the family Lauraceae, but Beadle, Evans & Carolin (1963 & 1972) recognized the monogeneric Cassythaceae.

In the brief accounts in floras of areas other than Australia, systematists (Stapf in Thiselton-Dyer, 1912 & 1913; Kostermans, 1950; Hutchinson & Dalziel, 1954; Takhtajan, 1959; Gooding, Loveless & Procter, 1965; Ching-En Chang, 1967; Cronquist, 1968) have mostly treated *Cassytha* as a genus of the family Lauraceae, but Britton & Millspaugh (1962) place it into Cassythaceae Dumont.

Sastri (1962, p. 205), discussing the systematic position of *Cassytha* and how it differs from other genera of Lauraceae, listed ten features which are common with the majority of other members so far studied. He continues, "*Cassytha* also shows some distinctive features which are not shared by other members of Lauraceae", and also, "The four points of difference mentioned above do not seem to be so significant as to warrant the removal of *Cassytha* from the Lauraceae". He stated that in his classification he agrees with Meisner, Mez, and Bentham and Hooker in assigning the genus *Cassytha* to a separate suborder or tribe. A year later Sastri (1963, p. 428) concluded that there is no justification for removing *Cassytha* from Lauraceae into a separate monogeneric family as suggested by Lindley (1853) and certain later authors (Sastri, 1962).

In this revision, I treat *Cassytha* as a genus of the family Lauraceae, the position first given by Jussieu (1789).

Taxonomic Criteria

Morphology

Habit

All species of *Cassytha* are at maturity rootless, perennial, herbaceous, chlorophyllous, obligate parasites, lacking tendrils but attached to their hosts by haustoria along the stems.

Anatomy

Comparatively little work had been done on the floral anatomy of the Lauraceae until Sastri (1952, 1962 & 1963). He made a detailed study of the floral anatomy of *Cinnamomum inners* Reinw. and *Cassytha filiformis* L. (Sastri, 1952, pp. 241-243).

Stems

The thread-like stems or branchlets have a diameter of 1-3 mm and branch profusely and monopodially, as they twine around the host or each other. The younger branchlets may be greenish in colour from chlorophyll but eventually may become green-black to orange-red. Unlike certain other parasitic plants there is no mimicry of the host, nor does the host influence the colour of the parasite. The unexposed parts of the stem, as well as the fruits, commonly remain green, even after drying.

A prominent feature of the stem is the development of rugae on the surface, these rugae becoming exaggerated in drying. Although I consider the rugae to be too variable and to show too much gradation between forms to be used as a taxonomic character, it was used by Ludwig (MS) and later Tepper (1888) to distinguish *C. tepperana* from *C. pubescens*. These are now considered synonymous. This development of rugae is particularly prominent in forms of *C. pubescens* from parts of Eyre Peninsula and Kangaroo Island, in South Australia, and from the Blue Mountains in New South Wales.

The only stem character I have used in distinguishing taxa is the indumentum, which is dealt with separately.

Dealing with anatomy of the stem in *Cassytha filiformis* L., Kostermans (1957,

p. 246) described the epidermis as consisting of heavily cutinized, square cells, with stomata in rows and pores at right angles to the axis. The outer part of the cortex has 1-6 layers of rounded, rather small cells and the endodermis is not differentiated at an early stage. The phloem is situated in the form of strands in furrows in the outer periphery of the xylem. The xylem forms a continuous cylinder, internally bounded by groups of protoxylem which extend into the pith. However, the vessels of the secondary wood are larger and reach 120 μm or more in diameter.

Haustoria

The haustoria are 1-2 mm in diameter, sometimes more, and single or in a series (to eight or more) formed on contact with a host. They are rarely only wart-like, not reaching the host, and often observed as adhering to their own stem-branchlet. Adherence and actual connection with the host plant is, according to Schroeder (1978, p. 126), by means of the development through the haustoria of internal anatomical continuity of the xylem from the parasite to the host plant.

B.G. Beaman (n.v., summarised in 'Dissertation Abstracts International' V. 32 (1972) 5644-B), investigated 5 species of *Cassytha*, where the haustoria were studied in terms of their origin and found to consist of two distinct parts, an attachment cup and a penetration wedge, each arising from separate meristematic areas of the parasite stem. Furthermore, the comparative studies of the stem and mode of parasitism revealed "There is no anatomical justification for the removal of *Cassytha* from the Lauraceae into separate monogeneric family". He also stated "Anatomically, *Cassytha* is very homogenous".

Indumentum

The hairs, where present, are simple, transparent, pale grey to black or red, with microscopic black or red particles providing the colour. The indumentum on petals and fruits is typical and constant for each taxon except *C. pubescens*. The stems and branches vary from glabrescent to pubescent in the same species and even on a single plant.

Leaves

Leaves in the family Lauraceae usually have a well developed lamina and petiole, are exstipulate and spirally arranged. In *Cassytha* the lamina and petiole are reduced; the *scaly leaves* measuring 0.5-5 mm long and lacking chlorophyll. Phyllotaxis is 1/3, compared with 2/5 and 3/8 recorded for other members of the Lauraceae.

In all species of *Cassytha* with triangular leaves and in some with ovate, the leaves are sessile and basifixed. A few species have ovate, shortly petiolate leaves consisting of an *anterior lamina* with a single unbranched vein (Fig. 1) and a *posterior lamina* which is not vascular and appears to be a secondary development in the evolution of this form of leaf. Leaves of this latter type are referred to as "peltate" in the text. The anterior portion of the leaf is fleshy in both forms, but below the point of attachment of ovate leaves the lamina is thinner. Leaves of all northern Australian species, for example, *C. filiformis* and *C. capillaris* are triangular to ovate and basifixed, while many southern species (*C. peninsularis*, *C. pomiformis*, *C. pubescens* and *C. racemosa* but not its f. *muelleri*) have peltate leaves. It is possible that the posterior thinner part was formed by a fusion of hastate lobes or spurs, although such lobes are not known to occur in the Lauraceae. Alternatively the posterior lobe may constitute a new structure resulting from an outgrowth from the leaf or the migration of the petiole from the base of the lamina. Its absence from the other members of the Lauraceae suggests that it is an 'advanced' character. Only in distinguishing the forms of *C. racemosa* has this character been found to contrast enough for its use taxonomically.

Most species have hairy leaves, but the hairs are usually (perhaps always) confined to

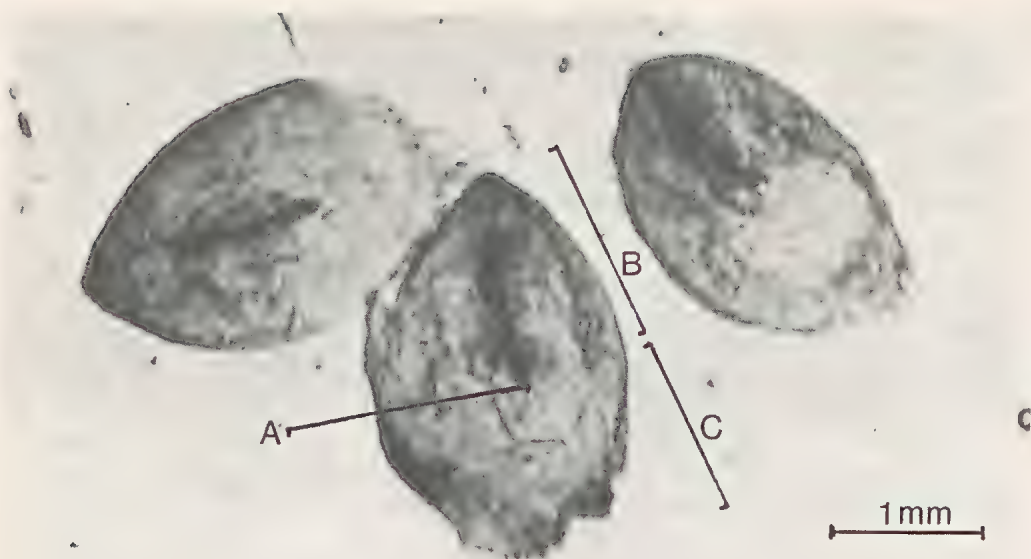


Fig. 1. Peltate leaves of *Cassytha pubescens*. A, place of attachment; B, anterior lamina with simple vein; C, posterior lamina with cilia.

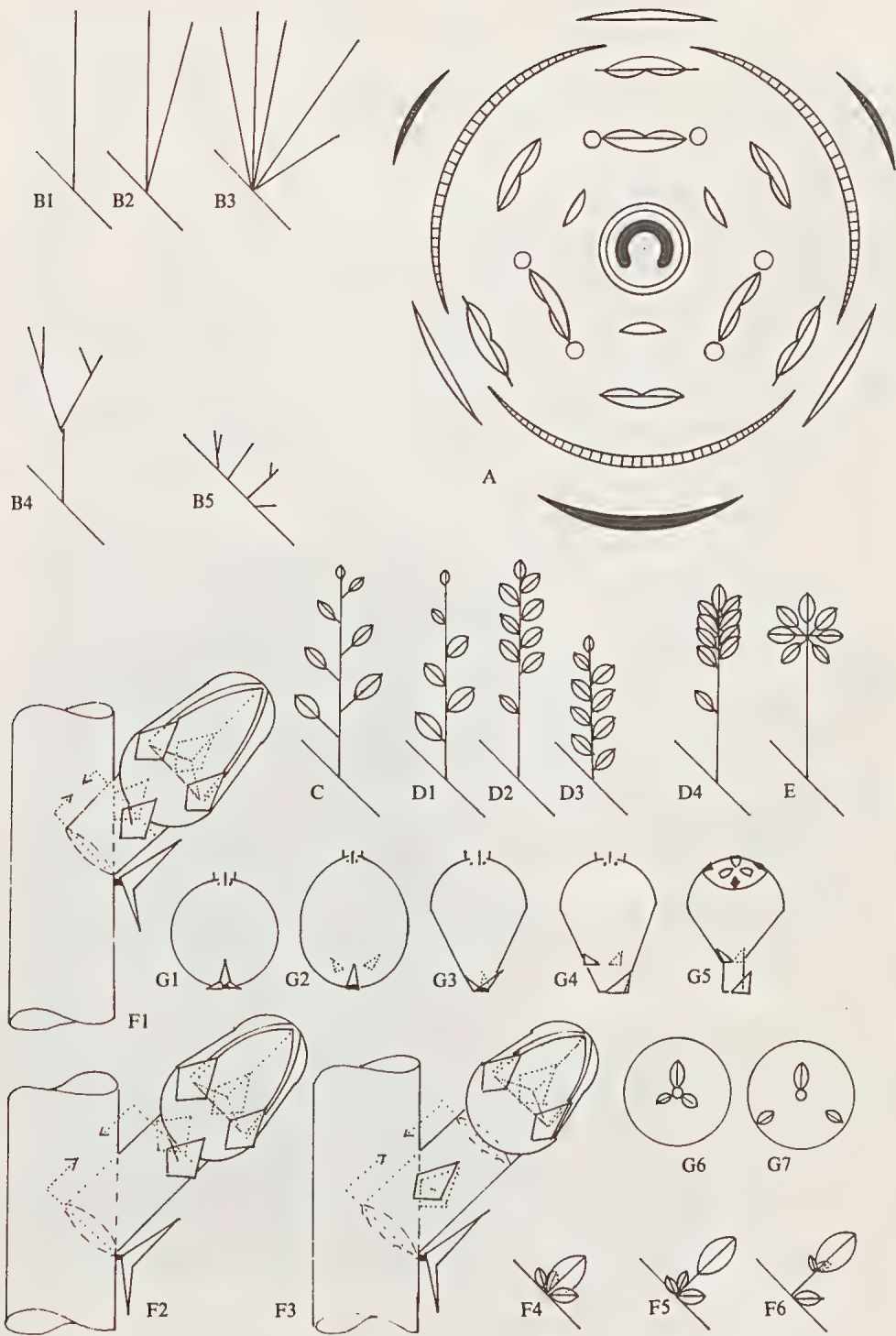
the upper surface. The hairs are often spread centrifugally from the centre of the lamina, are all retrorse, or are confined to the margin of the leaf. There is frequently a gland on the upper surface in the central portion of the lamina, commonly with a transverse saddle in the middle (see Fig. 21, O); it is pubescent or glabrous. Although usually occurring on all the leaves of an individual, plants with and plants without both occur in a species and, as such, this attribute has no taxonomic value.

Inflorescence

The inflorescence is always axillary. The basic unit is a (mostly short) spike, rarely a raceme, seldom a panicle (see Fig. 2, B1-5 & C), and usually thinner than the branches but with a denser indumentum (except in *C. glabella* which is glabrous). Flowers may be loosely arranged along the axis, or congregated in a loose or congested head or umbel (see Fig. 2, D1-4 & E). The head may be quite sessile forming a glomerule, or on a long or short peduncle.

Bracts: There is an axillant bract with two smaller bracteoles at the base of each peduncle and each of its branches. At the base of each pedicel is a bract, referred to in the text as the "floral bract", inserted at the attachment of the pedicel to the peduncle (see Fig. 2, F1-6). In addition there are two usually smaller bracteoles, referred to in the text as the "floral bracteoles". If the bracteoles are at the base of a short pedicel (not exceeding 0.3 mm), in one plane with the bract ("verticillate") and entirely concealing the pedicel, the flower is

Fig. 2. Diagrams of *Cassytha* inflorescence types and floral parts. A, floral diagram. B, inflorescence arrangements: B1, single; B2, paired; B3, fasciculate; B4, paniculate; B5, glomerulate. C, raceme. D, spike types: D1-3, loose; D2, elevated; D3, sessile; D4, congested. E, umbel. F, floral bract arrangements: F1 & 4, sessile with verticillate bracts; F2, 3, 5, 6, pedicellate; F2 & 6, pedicellate, floral bracts in two planes, bracteoles supporting the flower; F3 & 5, pedicellate with floral bracts verticillate at the base of the pedicel. G, fruits: G1 & 6, globose and sessile with verticillate floral bracts; G2 & 7, ovoid and pedicellate with floral bracts in two planes; G3 & 6, pyriform and sessile with verticillate floral bracts; G4 & 7, pyriform and pedicellate with floral bracts in two planes; G5 & 7, pyriform and pedicellate, pedicel cylindrical, floral bracts in two planes; G6, floral bracts verticillate (viewed from below); G7, floral bracts in two planes (viewed from below).



then termed "sessile" (see Fig. 2, F1 & 4). In "pedicellate flowers" the pedicel is visible, exceeding the axillant bract. Rarely, in species with pedicellate flowers, as in *C. pomiformis*, the bracteoles are verticillate (see Fig. 2, F3 & 5). Or the bracteoles may be remote from the bract when the floral bracts are referred to in the text as being "in two planes"; the bracteoles close to the flower and with their bases flanking the pedicel (see Fig. 2, F2 & 6).

Flowers

Perianth: Bentham (1870), in describing the flower of *Cassytha*, used the term "perianth" for all six segments, three outer and three inner. Mez, in 'Jahrb. Kgl. Bot. Gart. Berlin' 5 (1889), "Stressed the apetalous nature of the (Lauraceae) flower by pointing at *Cassytha*" (cited by Kostermans, 1957, p. 14) with which the latter author agreed, terming all the segments "tepals" (l.c. p. 53). The flower shows a P_{3+3} , $A_{3+3+3+3}$, G_1 arrangement and, according to anatomical investigations (Kostermans, 1957, p. 13), the two perianth whorls appear simultaneously (l.c. p. 13). The present author, contrary to Kostermans, terms members of the outer whorl sepals and the inner petals to distinguish these rather distinct whorls, as did Rendle (1938) and Saunders (1939), cited by Sastri (1952, p. 243).

Sepals: The sepals resemble floral bracts in size, shape and indumentum if present and are occasionally treated by some authors as representing a transition from bracts to sepals. They are furnished with one central vascular bundle (Sastri, 1952, p. 243). At the flowering stage they are more fleshy than leathery and usually situated close to the floral bracts, especially to the bracteoles; in fruit they are leathery and elevated, with the petals at the top of the enlarged receptacular tube, remote from the bracts.

Petals: The petals at flowering are fleshy and triangular, occupying most of the flower; they are furnished with three vascular bundles included in a broad ring of parenchymatous tissue (Sastri, 1952, p. 243). At first they are green, later in flower they may turn slightly yellow-green or red-green and in fruit become leathery, brown to black, spreading, erect or intumed and more or less closing the orifice. Seldom does the margin differ from the rest of the lamina in having a rim slightly yellower or red (more conspicuous when dry) or in lacking the pubescence as in *C. melantha*. The petals, in flower, appear as a continuation of the receptacular tube, at first always green, glabrous or pubescent on both or only one surface, or rarely papillose inside as in *C. glabella* f. *bicallosa*.

Receptacular tube: The receptacular tube is very short in the flower. It is glabrous or pubescent outside and/or inside, and in most species it is concealed by the floral bracts at the flowering stage. See description of fruit for subsequent development of the receptacular tube.

Stamens: The primitive Laurales are thought to have had four-celled anthers (Kostermans, 1957), but in *Cassytha* they are two-celled, each cell with one flap. Of the four whorls of the androecium, the first second and fourth are supplied by single vascular bundles and only the third is supplied with three bundles which bear the lateral glandular outgrowths. In the stamens of the third whorl the bundles pass to the lateral glands at the base of the filaments. According to Sastri (1952, p. 245) "Saunders (1939) is of the opinion that the stamens in the family are the result of chorosis; Reece (1939), on the other hand, favours the view that they are derived by reduction from an original branch system." *Cassytha* is generally considered to have undergone greater androecial reduction than other genera (e.g. *Cinnamomum* and *Persea*). The filaments are usually narrower than the anthers, but in the stamens of the first (outer) whorl are often expanded laterally and are nearly half as wide as long and, in Australian species, frequently apiculate. In the cell of the young anther the primary archesporium consists of a hypodermal layer five to six cells wide according to Sastri (1962, p. 197). These cells divide periclinally and form a tapetum

of which the cells become two-nucleate and later divide meiotically. As a result of mitotic divisions in the primary sporogenous cells about a hundred microspore-mother-cells are formed in each anther lobe.

Pollen: According to Sastri (1962, p. 197), the pollen tetrads are tetrahedral or isobilateral in *C. filiformis*, *C. pubescens* and *C. glabella* which he studied. Mature pollen grains are two-celled, acolpate and filled with fat globules. They are usually shed when the ovules are at the megaspore-mother-cell stage. They measure about 40 μm diameter in *C. filiformis* and *C. glabella*, but in *C. pubescens* the pollen grains are about 60 μm diameter.

Ehrendorfer et al. (1968, p. 344) gave for Lauraceae the uniform chromosome number of " $x_2 = 12$ ", with detailed numbers for some "Lauroideae" but no account for "Cassythoideae". I found (with P.M.C. squashes in aceto-carmin) in each tetrad of *C. pubescens* the chromosome number to be $n = 24$, which is in agreement with the formula presented by Ehrendorfer earlier. (See Fig. 3).

Staminodes: The stamens of the fourth whorl are always sterile, having one vascular bundle, lacking cells and being pyramidal or cordiform. The third whorl of stamens (often in *C. filiformis*) or the second (antipetalous) whorl (in *C. racemosa*) are strap-like, if they lack cells. If the reduction is less complete, one locule still being present, they accordingly bulge asymmetrically.



Fig. 3. Chromosomes of *Cassytha pubescens* (Weber 6247, AD). Pollen Mother Cell squash at second metaphase. Photomicrograph (left), camera lucida drawing (right).

Glands: A pair of glands is associated with the stamens of the third whorl. Each gland is furnished with a vascular bundle which is derived from the inner large bundle divided into three in a radial arrangement (Sastri, 1952, p. 243). According to Kostermans (1957, p. 15), anatomical evidence shows that the glands which are widespread in the Lauraceae are not reduced staminodes, as had been suggested previously, and they contain "Oil cells and a rudimentary vascular bundle". In *Cassytha* they are shortly attached to the filaments and they completely fill the space between the filaments. However, Kostermans did not say what he believed the origin of the glands to be.

Ovary: Although the ovary is one-celled, with only one ovule, there is evidence that it is composed of three carpels, a condition termed pseudo-monomerous (Kostermans, 1957, p. 16). The stigma of *Cassytha* is sometimes slightly three-lobed, although this may be caused by compression in the bud by the three petals. The ovary is superior in the flower, showing during fruit development the transitional stages to perigyny. Formation of the ovary, as Sastri (1962, p. 198) described, is similar to that described for *Cinnamomum* (Sastri, 1958).

Ovule: The ovule is pendulous, anatropous, crassinucellate and bitegmic (Sastri, 1962, p. 198). The primordium becomes bent at the megaspore-mother-cell stage and finally the micropyle faces the style. The primary archesporium is multicellular and numerous megaspore-mother-cells are formed; as many as six embryo sacs may develop simultaneously in a single ovule; finally one to four of them protrude beyond the nucellus and enter the funiculus. The inner integument is two cells thick in *C. filiformis* and *C. pubescens*; in *C. glabella* it is thicker. The outer integument is four or five cell layers thick. After fertilization, the inner integument gradually disintegrates but the outer integument increases in thickness. Cells of the outer epidermis of the ovary become filled with tannin and form an outer fleshy zone; the cells of the inner epidermis acquire band-shaped helical thickenings and form a wall of a stony layer in the fruit.

Fruits

The fruit is mostly globular and is covered by the persistent calyx, which structure is called a "flower tube" by Kostermans (1957, p. 17) but which I term a "receptacular tube", although studies have not been conducted to establish with certainty whether this tube is derived from the receptacle or perianth. This is in agreement with Chakravarty (1969, p. 752) but Rendle (1963, p. 136) referred to it as a perianth-tube. Meisner (1864) called it a cup. It is at first very short, fleshy, (ob) conical and smooth. After pollination it enlarges more quickly than the ovary. During maturation the fruit is almost completely enclosed in the accrescent receptacular tube, which later becomes succulent underneath, the pericarp remaining dry, firstly green, later becoming dark-brown to black. Chakravarty (l.c.) considered that during the short course of fruit development, *Cassytha* shows a series from complete epigyny in the flower through perigyny to hypogyny when in fruit. As the receptacular tube is not fused with the fruit wall, it is considered preferable to refer to it rather as perigynous. The outer perianth segments are inserted on the rim, where the receptacular tube gradually merges with the base of the fleshy petals. In fruit the floral bracts are variously attached to or free from the lower part of the tube. In species with sessile flowers the floral bracts are verticillate at the base, touching each other laterally (see Fig. 2, G1, 3 & 6). In pedicellate flowers several arrangements occur. Only in some forms of *C. pomiformis* and *C. racemosa* the pedicel remains distinct in fruit, in all other species it becomes fleshy and incorporated into the false fruit together with the receptacular tissue. In forms of *C. pomiformis* which retain their pedicel in fruit, the bracteoles may be borne at either end of the pedicel. In the forms of *C. racemosa* which retain their pedicel the bracteoles are on opposite sides of the base of the false fruit. In all other forms of these species and all other species the bracteoles occur on the lower part of the false fruit (see Fig. 2, G2, 4 & 7), the space separating them from the axillant bract indicating the

contribution of the pedicel to the false fruit.

Endosperm: Endosperm is of the cellular type and in the mature seed is consumed by the growing embryo (Sastri, 1957, p. 240).

Embryo: Fertilization is essentially porogamous in *C. filiformis* (Sastri, 1962). After fertilization, the first division of the zygote is transverse. The mature embryo has a differentiated procambium and massive cotyledons, enclosing the plumule and leaf primordia, as in other autotrophic members of Lauraceae. "After discussing the bearing of embryological data" (Sastri, 1963, p. 428), "There is no justification for removing *Cassytha* from Lauraceae into a separate unigeneric family as suggested by Lindley (1853) and certain authors (Sastri, 1962)".

Cotyledons: The cotyledons are well developed, composed of two large, plano-convex halves, more or less fused, white and containing fatty oil, carbohydrates and proteins (Kostermans, 1957, p. 19). In *C. melantha* I was quite successful in separating them in the mature stage and exposing the embryo with its attachments to the cotyledons, but in other species cotyledons were consolidated and indistinguishable in the ripe seed. This problem was mentioned by R. Brown and others and discussed more fully by Bentham (1870, p. 308), who was informed by Dr Thwaites that "it is only at an early stage that the cotyledons are developed distinct in *C. filiformis*".

Biology

Dispersal of the seeds: The chief method of reproduction seems to be seed, which is abundantly produced each season. The false fruit is one-seeded, fleshy, glossy and smooth, green, sometimes red or yellow, with a taste usually bitter (somewhat similar to a *Pinus* leaf) and aromatic. It is apparently dispersed by birds, probably also by possums, which are attracted by the glossy "berries". The coat of bony exocarp presumably protects the embryo when swallowed.

Germination: According to Ewart (1919, pp. 370-371) and Kostermans (1957, p. 246), seed germinates best in almost pure sand and occurs in (spring) September and October. The hypocotyl escapes and forms a simple root. Side roots soon develop, furnished with root hairs and replacing the main root; the roots not having a root-cap. The food is rapidly absorbed from the cotyledons and remains dissolved in the cell-sap as sugar. The hypocotyl attenuates rapidly into a filamentous green axis and carries up the epicotyl within the fruit wall. The cryptocotylar mode of germination is regarded as advanced according to Sporne (1969). When the endosperm has been absorbed, the empty seed coat falls off. The first scale leaves are borne 5-9 cm from the ground. The seedling shows active clockwise circumnutation. After good parasitic attachment has been established, the basal part of the seedling shrivels and dies.

To promote germination under artificial conditions it is necessary to file the bony fruit wall. Sporadic bush fires in nature may facilitate germination by burning the fruit wall and also encourage the growth of lower shrubs and bushes needed by *Cassytha* as hosts after germination. In nature the fruit wall may also be damaged by digestive processes if swallowed by animals, or by decay.

Selection of the host: Generally the selection of the host by *Cassytha* is not very specific, but preferences may be noticed in some species, for example, rejection of some euphorbiaceous species in Australia. The most robust representative, *C. melantha*, is commonest on *Eucalyptus* spp., and flourishes well above the ground; *C. glabella* has been seen creeping on the ground, twining over grasses, as well as over a range of bushes. *C. aurea* and *C. peninsularis* occur on coastal dunes, growing on grasses and low matted bushes, but also further inland on shrubs (*Melaleuca* spp.) and low trees. I have observed *Cassytha* on aliens such as *Lycium ferocissimum* and *Pinus radiata*. *C. filiformis*

(Schroeder, 1978) has a large range of hosts, including *Persea americana* (avocado), a member of the same family, Lauraceae.

Annual growth: In *Cassytha*, annual growth as well as flowering and fruiting depend primarily on the rainfall, but weather conditions only indirectly affect the *Cassytha* plant through its host. Apparently, vegetative growth is diminished at flowering and fruiting. In favourable conditions *Cassytha* forms large tangled masses, often hanging 1-2 m from the hosts covering bushes in a thick layer, both hosts and parasite dying out gradually in the lower layers. It has been observed that fewer flowers are produced by heavily infested host plants. Ultimately the host may die, resulting also in the death of the parasite.

Pollination: I have not observed any particular insects on the flowers as possible pollinators, nor has any other information on pollination been found in the literature. The presence of the glands in the flower, and the quite long flowering period of several weeks may suggest insect pollination or wind pollination; on the other hand the introrse stamens and the small flowers may achieve self pollination.

Distribution

The great diversity of *Cassytha* species in Western Australia is evident from Table 1. In that State the genus is represented by ten of the fourteen Australian species and three varieties and six forms. Of these, five species, two varieties and four forms are endemic to Western Australia.

Other States all have far fewer taxa; Queensland being the richest of these.

Table 1. Occurrence of *Cassytha* species by State, with indication on non-Australian distribution.

<i>Cassytha</i>	W.A.	N.T.	Qld	N.S.W.	Vic.	Tas.	S.A.	Other
1. <i>aurea</i>								
var. <i>aurea</i>	+	•	•	•	•	•	•	
var. <i>candida</i>	+	+	•	•	•	•	•	
var. <i>hirta</i>	+	•	•	•	•	•	•	
2. <i>capillaris</i>	+	+	+	•	•	•	•	Malaysia and New Guinea
3. <i>filiformis</i>	+	+	+	+	•	•	•	pantropic
4. <i>flava</i>	+	•	•	•	•	•	•	
5. <i>glabella</i>								
f. <i>glabella</i>	+	•	+	+	+	+	•	
f. <i>bicallosa</i>	+	•	•	•	•	•	•	
f. <i>casuarinae</i>	+	•	•	•	•	•	•	
f. <i>dispar</i>	+	•	•	+	+	+	+	
6. <i>melantha</i>	+	•	•	+	+	+	+	
7. <i>micrantha</i>	+	•	•	•	•	•	•	
8. <i>nodiflora</i>	+	•	•	•	•	•	•	
9. <i>pedicellosa</i>	•	•	•	•	•	+	•	
10. <i>peninsularis</i>								
var. <i>peninsularis</i>	•	•	•	•	•	•	+	
var. <i>flindersii</i>	•	•	•	•	•	•	+	
11. <i>pomiformis</i>	+	•	•	•	•	•	•	
12. <i>pubescens</i>	•	•	+	+	+	+	+	New Zealand
13. <i>racemosa</i>								
f. <i>racemosa</i>	+	•	•	•	•	•	•	
f. <i>muelleri</i>	•	•	+	•	•	•	•	
f. <i>pilosa</i>	+	•	•	•	•	•	•	
14. <i>rufa</i>	•	•	+	•	•	•	•	
Total taxa	16	3	6	5	4	5	5	
Total spp.	10	3	6	5	4	4	4	

Map 1 shows the distribution of *Cassytha filiformis* (circles) in Australia and of all other species (solid spots). The absence of the genus from the Eremaean Zone is conspicuous.

Origins

Sastri (1952, p. 240) and Hutchinson (1969, p. 140) thought that the family Lauraceae was derived from the Magnoliales by reduction. *Cassytha* shows close similarities with most other genera of the Lauraceae in the attributes: trimerous flowers; two perianth whorls with slight differentiation; several staminodal whorls—usually four in Lauraceae—with one or two whorls in *Cassytha*; dehiscence of anthers by flaps; single carpel with one pendulous ovule; similarities in the vascular supply of various organs. However, the main differences occur in the structure of the stem and leaves. All other members of the Lauraceae are woody shrubs or trees with well-developed short- or long-petiolate leaves, while *Cassytha* has parasitic filiform stems with a specially developed vascular system for the transport of food in both directions and vestigial leaves.

Any discussion of the origin of *Cassytha* or its further dispersal is speculative. So far, no fossil record of *Cassytha* has been found in Australia, which is where it is now most widespread, nor am I aware of any record in other continents. There are no obvious links between *Cassytha* and the other members of the Lauraceae from which I believe it evolved, nor are there any morphological characters of definite value in determining the primitive or advanced status of any *Cassytha* species.

A knowledge of the present distribution of the genus may be helpful. *Cassytha filiformis* is spread mainly through the tropics of America, Asia, and Australia. No other species has yet been described from America. A second species occurs in Asia as well as in Australia, and a further three species are endemic in Africa. In Australia there are 14 species, with the greatest number in south-western Western Australia, but an equally great morphological range occurs in the southern Dividing Range. At least two of the African endemics are more closely related to Australian species than to *C. filiformis*.

While it cannot be established when the genus originated, its great morphological deviation from a family usually considered to be amongst the most primitive suggests a great antiquity. The rather restricted distribution in America and Eurasia and the few taxa which exist elsewhere may also signify a long history.

One possibility which should be considered, in view of the occurrence of the genus in Africa, America, Australia, India and New Zealand, is that it first appeared in Gondwanaland before the separation of the southern continents. Other possibilities are that it arose in the old-world tropics or that it evolved in Australia either over a wide area or, perhaps, in one of the areas, particularly rich in modern *Cassytha* species, after the Gondwanaland split.

In my view the best hypothesis at this stage is that parasitism arose in the Lauraceae in Australia in, or after, the Eocene when Australia separated from the rest of Gondwanaland. Of existing species, *C. pubescens* represents in its variability a link between most other species in Australia and is still evolving, to the extent that some of the extreme forms, which were previously described as different species, have not completed speciation. From it the evolution of most species from *C. pubescens* appears to be a relatively simple possibility. The widespread *C. filiformis* and, to a lesser extent, *C. capillaris* also appear possibly to have arisen from this stock.

The most robust representative of the genus, *C. melantha* is widespread through southern Australia and retains a homogenous habit throughout, but the thinner and finer *C. glabella* inhabiting nearly the same area shows variation in its fruits in different regions. The similarities of these two species with *C. pubescens* are not as great as are those of other species, and their affinities are not clear.

Taxonomic Concepts

All characters used in delimiting taxa in this work are morphological and can be observed on herbarium material using a lens or light microscope. As far as possible, taxa are distinguished from one another on more than one diagnostic character. However, some weighting of characters has been employed, resulting in some taxa being distinguished on single characters with subsidiary characters showing incomplete correlation. One exception is in distinguishing *C. pubescens* from *C. rufa*. Here it was found necessary, because of the complexity of the former, to employ combinations of both indumentum and fruit characters to identify it. Varieties and forms are also characterised entirely on morphological characters, the number of characters and the weight allotted to each character being used to determine the level. Thus, for example, *C. pubescens* and *C. aurea* are distinguished on flower size which correlates with geographical distribution and on a combination of other characters. *C. aurea* var. *aurea* is distinguished from var. *hirta* on the basis of indumentum density and the degree of congestion of the flowers in the spike, both being considered insufficient to warrant species status. The four forms of *C. glabella* are distinguished only by the different shapes of the fruit. Similar criteria are applied in *C. racemosa* f. *racemosa* and f. *pilosa*, but f. *muelleri* is distinguished on the characters of the leaves and bracts being ovate-peltate or triangular-basifixed.

The morphological differences usually coincide with the geographical distribution of the taxa, but the distribution of the plants is, when used, always a secondary character in distinguishing taxa.

CASSYTHA L.

(Greek name *kasytas* or *kadytas* for *Cuscuta*, dodder.)

Cassytha (Osbeck. ined.) L., Sp. Pl. 35 (1753); Gen. Pl. 22 (1754); Nees, Syst. Laur. 642 (1836); Hook. f., Fl. Tasm. 1: 317 (1857); Meisner in DC., Prod. Syst. nat. Regni veg. 15: 252 (1864); Bentham, Fl. Austral. 5: 308 (1870); F.M. Bail., Queensland Fl. 4: 1313 (1901); Diels & Pritzel, Bot. Jahrb. Syst. 35: 201 (1905); Stapf in Thiselton-Dyer, Fl. Cap. 1: 500 (1912); Allen, J. Arnold Arb. 23(2): 154 (1942); Kostermans in Humbert, Fl. Madagascar Fam. 81: 84 (1950); Kostermans, Reinwardtia 4(2): 193 (1957); Allan, Fl. New Zeal. 1: 137 (1961); Back. & Bakh. f., Fl. Java 1: 135 (1963); Hutchinson, Gen. Flowering Pl. 1: 143 (1964); Curtis, W.M. Stud. Fl. Tasm. 3: 596 (1967); Burbidge & Gray, Fl. A.C.T. 176 (1970); Beadle, Evans & Carolin, Fl. Sydney Reg. 152 (1972); Willis, Handb. Pl. Vict. 2: 159 (1973); Chang, Fl. Taiwan 2: 409 (1976).

Holotype: *C. filiformis* L. (the only species recognised by Linnaeus, 1753).

Synonymy

For fuller synonymy and use of orthographic variants (*Cassyta*, *Cassitha* and *Cassita*) see Kostermans, Bibl. Laur. 215-219 (1964).

'Rombut' (Rumphius, Herb. Amb. 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750), nom. vern.); Adanson, Fam. Pl. 2: 284 (1763).

Holotype: *Cassytha filiformis* L. (no epithet has ever been combined with this generic name).

Volutella Forskal, Fl. Aeg.-Arab. 84 (1775).

Holotype: *V. aphylla* Forskal (= *C. filiformis* L.)

Calodium Loureiro, Fl. Cochinch. 247 (1790).

Holotype: *C. cochinchinense* Loureiro (= *Cassytha filiformis* L.).

Ozarthris Rafinesque, Fl. Tellur. 4: 92 (1836).

Syntypes: not lectotypified (*O. capense*, *O. opuntiioides*, *O. paradoxa*, *O. triquetra*).

Rumputris Rafinesque, Fl. Tellur. 4: 92 (1836).

Holotype: *R. fasciculata* (= *C. ?filiformis* L.).

Spirocnema Rafinesque, Fl. Tellur. 4: 92 (1836).

Holotype: *S. aphylla* ?(Forsk.) Rafinesque (= *C. filiformis* L.).

Pre-Linnean Synonyms

Acatsja-vali Rheede, Hort. Malab. 7: 83, t. 44 (1688).

Cuscuta-baccifera Plukenet, Almag. Bot. 3: 126, t. 172, f. 2 (1692).

Cuscuta altera Ray, Hist. Plant. 2: 1 (1704).

Cussuta Rumphius, Herb. Amb. 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750).

Rombut putri Rumphius, *ibid.* 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750).

Cuscuta-indica Rumphius, *ibid.* 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750).

Cussutha Rumphius, *ibid.* 5: t. 184, f. 4 (1747); *ibid.* 6: 491 (1750).

Perennial parasitic, partly autotrophic twiners, containing abundant mucilage, attached by small elliptical haustoria formed along the stem at points of contact with the host. *Stem* filiform or terete, glabrous or pubescent, first green later in some yellow-green to brown-black, sometimes warted, on drying irregularly striate. Epidermal cells heavily cutinized, squarish in surface view, containing chlorophyll and reddish crystals. *Leaves* clasping, reduced to minute scales, spirally arranged on both stem and inflorescence in 1/3 phyllotaxis. *Inflorescence* erect, sessile or stalked, bracteate, a panicle, spike or raceme or reduced to a sessile or stalked head; axillant bracts present on peduncle and at each of its branches; whole deciduous after fruiting. *Flowers* bisexual, sessile or shortly pedicellate, ovoid or obovoid before opening; the bract and two smaller bracteoles verticillate or "split" if in two planes. Perianth and androecium confined to the rim of receptacular tube in trimerous whorls. *Perianth* segments 6, free, persistent obscurely nerved; sepals 3, scale-like, similar to floral bracts; petals 3, larger, fleshy, ovate, bluntly acute. *Receptacular tube* at first short, turbinate, shallowly concave in flower, tapering gradually downwards into the pedicel and continuing into petals upwards, after fertilization becoming fleshy and enlarging to enclose the ovary. *Stamens* 12 alternating in 4 whorls of 3; 3 (or 2) whorls fertile; 1 (or 2) represented by staminodes, usually white, drying brown. *Anthers* 2-celled, dehiscing from below by a distally-hinged flap (operculum). Stamens of the first whorl opposite sepals, always fertile, petaloid, by lateral expansion of filaments and connective, ovate to oblanceolate, cells terminal, introrse. Stamens of the second whorl opposite and shortly adherent to petals, fertile or sterile, fusiform; cells terminal, introrse. Stamens of the third whorl fertile or sterile, fusiform, resembling those of the first whorl, but slightly smaller, if fertile extrorse, with cells sub-terminal; with an ovoid gland on either side of the filament base often tipped with a white glandular appendage. Stamens of the fourth whorl sterile, opposite the stamens of the second whorl, shortly stipitate, fleshy, laterally compressed-ovoid, acute, cordate or pyramidal, about half the size of fertile stamens, sometimes tipped with glandular appendage similar to gland's tip which remains white on drying. Pollen acolpate. *Carpel* apparently solitary, erect, white, drying brown; ovary globular, unilocular with one pendulous anatropous ovule; style short, capitate stigma drying darker than ovary, persisting in fruit but not protruding beyond receptacle. After fertilization ovary forming crustaceous pericarp (bony putamen) which is enclosed by the fleshy receptacular tube. *Fruit* globular, bearing on top the lignified perianth and androecium sometimes encircled by glandular ring. *Pericarp* consisting of an inner canescent layer, a bony layer c. 0.5 mm thick and a thin rugose dark brown layer, surmounted by the base of the style expanded into a darker fringed cap. Seeds exendospermic; cotyledons thick, hemispherical, fleshy, yellowish, distinct only in the early stage, in central portion connected to embryo; radicle vertical.

Of 17 species at present recognised in the world, one species (*C. filiformis*) is cosmopolitan mainly in the tropics, but never very far inland; three species are endemic to

Africa; fourteen species occur in Australia, ten are endemic, one shared with Malaysia, two with New Guinea and one with New Zealand.

Key to *Cassytha* species and varieties in Australia

1. Plant glabrous; cilia and fimbriae absent from bracts and sepals 2
Plant pubescent and/or bracts and sepals ciliate or fimbriate 4
2. Flowers and fruits pedicellate (Tas.) 3. *C. pedicellosa*
Flowers and fruits sessile 3
3. Flowers less than 0.8 mm long; spirally arranged in spike (W.A.) 2. *C. micrantha*
Flowers over 1.3 mm long; distally crowded in head 1. *C. glabella*
4. Flowers and fruits subsessile; pedicel none or minute and concealed by the whorl of floral bracts 5
Pedicels at least 0.3 mm long, conspicuous; insertion of bracteoles remote from bract (except occasionally in *C. pomiformis*) 16
5. Flowers and fruits in sessile glomerules or heads 6
Flowers and fruits in elevated heads or spikes 7
6. Petals and fruits glabrous (W.A.) 9. *C. nodiflora*
Petals and fruits pubescent 6. *C. pubescens*
7. Petals glabrous 8
Petals pubescent 9
8. Fruit glabrous, globular, greenish (drying black); peduncle c. 0.5 mm thick 7. *C. filiformis*
Fruit strigose, ovoid, reddish (never drying black); peduncles 0.3-0.4 mm thick (dried) (W.A., N.T., Qld) 4. *C. capillaris*
9. Flowers in heads 10
Flowers in panicles or spikes 14
10. Peduncles less than 0.5 mm thick; flowers globular; floral bracts equalling flowers, conspicuous in flower-head (W.A.) 5. *C. flava*
Peduncles more than 1 mm thick (dried); flowers ovoid; floral bracts smaller than flowers, not protruding from flower-head 11
11. Staminodes and basal glands with white glandular appendage (W.A.) 10a. *C. aurea* var. *aurea*
Staminodes and basal glands without apical white glandular appendage 12
12. Fruit glabrous; stamens of the first whorl at least twice as long as broad (W.A., N.T.) 10b. *C. aurea* var. *candida*
Fruit pubescent (sometimes sparsely so); stamens of the first whorl c. $1\frac{1}{2}$ times as long as broad 13
13. Bracteoles on peduncle remote from bract; staminodes and glands dark tipped (W.A.) 10c. *C. aurea* var. *hirta*
Bract and bracteoles verticillate; staminodia uniform coloured 6. *C. pubescens*
14. Pubescence on petals short, black, retrorse; fruit glabrous, smooth, green (drying black) 12. *C. melantha*
Pubescence on petals white and red, not retrorse; fruit pubescent, smooth or papillose (drying variously) 15
15. Fruit papillose, ribs and glandular ring absent, drying brown (Qld) 11. *C. rufa*
Fruit smooth, sometimes with raised ribs or/and with glandular ring, drying grey-black 6. *C. pubescens*
16. Fertile stamens 6 (second whorl opposite petals sterile, lacking cells) 14. *C. racemosa*
Fertile stamens 9 17
17. Flowers in (elevated) umbels; peduncle at fruiting clavate (W.A.) 13. *C. pomiformis*
Flowers in loose or congested heads (not umbels) or racemes 18
18. Flowers in loose heads or racemes; petals pubescent, green-grey (dried) (Qld, N.S.W., Vic.) 6. *C. pubescens*
Flowers in congested heads: petals glabrescent, yellow (dried) (S.A.) 19
19. Staminodes and glands with white glandular appendage; ovary with ring of hairs medially; fruit streaked with alternate bands of white and red hairs, drying brown 8a. *C. peninsularis* var. *peninsularis*
Staminodes and glands without glandular appendage; ovary glabrous; fruit glabrescent not streaked, drying black 8b. *C. peninsularis* var. *flindersii*

1. *Cassytha glabella* R. Br., Prod. Fl. Nov. Holl. 404 (1810), pro parte, as to the lectotype only; Sprengel, Syst. Veg. 2: 271 (1825); Nees, Syst. Laur. 645 (1836); Hook. f., Fl. Tasm. 1: 318 (1857); Meisn. in DC., Prod. 15: 254 (1864); F. Muell., Pl. Indig. Vict., -t. 68 (1864-1865); F. Muell., Fragm. Phyt. Austral. 5: 167 (1866); Benth., Fl. Austral. 5: 309 (1870); Schomburgk, Fl. South Australia 55 (1875); Spicer, Handb. Pl. Tasmania 130 (1878); F. Muell., Syst. Census Austral. Pl. 4 (1882); Bailey, Synop. Queensland Fl. 427 (1883); Tate, Trans. R. Soc. S. Aust. 6: 149 (1883); F. Muell., Key Syst. Vict. Pl. 6, f. 5 (1885); F. Muell., Key Syst. Vict. Pl. 1: 125 (1887-1888); F. Muell., Native Pl. Vict. 1: 23, f. 4 (1889); F. Muell., Sec. Syst. Census Austral. Pl. : 7 (1889); Tate, Census Indig. Flower. Pl. Extra-trop. South Australia 70 (1889); Tate, Handb. Fl. Extra-trop. South Australia 205 (1890); Bailey, Cat. ind. natur. Pl. Queensland 39 (1890); Moore, Handb. Fl. New South Wales 19 (1893); Bailey, Queensland Fl. 4: 1314 (1901); Diels & Pritzel, Bot. Jahrb. Syst. 35: 201 (1905); Dixon, Pl. New South Wales 33 (1906); Bailey, Compr. Cat. Queensland Pl. 437, f. 422 (1913); Maiden & Betche, Census New South Wales Pl. 82 (1916); J.M. Black, Fl. South Australia 239 (1924); Domin, Biblioth. Bot. Band 22, Heft 89(2): 679 (1925); Ewart, Handb. Forest Trees Victoria 124 (1925); Ewart, Fl. Victoria 522 (1931); Gardner, Enum. Plant. Austral. Occ. 44 (1931); J.M. Black, Fl. South Australia 2(2): 365 (1948); Blackall & Grievé, How to Know Western Austral. Wildflowers 1: 169 (1954); Beadle, Evans & Carolin, Handb. Sydney Distr. 133 (1963); Curtis, Stud. Fl. Tasm. 3: 597 (1967); Beadle, Evans & Carolin, Fl. Sydney Reg. 152 (1972); Willis, Handb. Pl. Victoria 2: 159 (1973).

Type: R. Brown s.n. (Bennett 3018), King George's Sound (Western Australia), Dec. 1801 (BM, lecto.). Two specimens in BM were identified by Brown as *C. glabella*. One, with the locality King George's Sound, conforms with the type description. The other without locality, is pubescent, does not therefore agree with the type description and is identified by the present author as *C. flava*. No other duplicates have been located and the former is selected as the lectotype.

The following binomials cannot be placed in their appropriate forma due to lack of fruits.

C. micrantha Meisn. in DC., Prod. 15: 256 (1864): pro parte, excl. lectotype, quoad spec.:

Type: J. Drummond 152, "Swan River", (Western Australia), (K, NY, syn.); J. Drummond suppl. 61, "Swan River", (Western Australia), a. 1845 (K, MEL 58498, syn.).

C. microcephala Meisn. in DC., Prod. 15: 253 (1864): pro parte quoad spec.:

Type: J. Drummond 68, "Swan River", (Western Australia), (K, MEL 58373, syn.); R.C. Gunn 19, Phillip Island, (Tasmania), (K, syn.).

C. filiformis Thunb. (non L.), Prod. Pl. Cap. 78 (1794), nom. illeg., was placed by Nees (1836, p. 446) under synonymy of *C. glabella*. The present author is of the opinion that the latter does not occur outside of Australia and that *C. filiformis* sensu Thunb., which was based on material from Africa, is not synonymous with *C. glabella*.

Vernacular names

"Smooth Cassytha", Bailey, Queensland Fl. 1314 (1901); "Tangled Dodder-Laurel", Ewart, Handb. Forest Trees Vict. 124 (1925); "Slender or Tangled Dodder-laurel", Willis, Handb. Pl. Vict. 2: 159 (1973); "Slender Devil's Twine", Ingram, C.K., Coll. No. 296.126.

Stem (0.2-) 0.4-0.6 (-1) mm thick, glabrous, green or yellow to red-green, smooth, drying yellow-brown. Young shoots glabrous; *leaves* triangular or triangular-ovate, obtuse, 0.4-0.5 x c. 0.3 mm, basifixed, glabrous, yellow-green, drying brown. *Haustoria* oval, commonly less than 1 mm long. *Inflorescence* usually a single or rarely paired, elevated congested cluster or head, not umbellate; peduncles (4-) 7-8 (15) x c. 0.5 mm, usually narrower basally, glabrous, (2-) 4-6 (-10) flowered. Supporting bract triangular, 1-1.5 x 0.5-1 mm, basifixed, glabrous, yellow-green, fleshy to scarious, turning leathery and dark-brown; bracteoles similar or smaller, 0.5-1.5 mm long. *Flowers* sessile or rare

pedicellate, ovoid to obovoid, 1.3-2 (-3.2) x 1 (-2) mm, mostly white, rarely yellowish. Floral bracts verticillate (in one plane), spreading or erect, glabrous; bracts ovate, acute, 1-1.5 x 0.5-1 mm, basifixed, light-green to yellow-green tinted red with narrow scarious margin, bracteoles similar, smaller, c. 1 mm long. Receptacular tube short, green, glabrous. *Sepals* ovate, 0.5-1 x 0.4-0.8 mm, glabrous, yellow-green with white or yellow scarious margin. *Petals* ovate to oblong-ovate, 1-2 (-3) x 0.8-1 (-1.5) mm, glabrous or very rarely pubescent outside, inside glabrous or rarely pubescent, white, drying yellow-brown to reddish-brown, more or less ridged lengthwise. Fertile *stamens* 9, white, drying brown; stamens of the first whorl c. 1 (-2) x 0.5-0.7 mm, filament under cells expanded laterally, wider than cells; stamens of the second whorl oblanceolate, c. 1 (-2) x 0.3-0.5 mm, cells obcordate, wider than filament; stamens of the third whorl oblanceolate, c. 1 (-2) x 0.3-0.5 mm, cells obcordate, wider than filament, often bulging over staminodes and glands. Staminodes pyramidal to wedge-shaped, 0.7 (-1) x 0.2-0.3 mm, shortly stalked, white, turning brown; gland ovoid to obovoid, $\frac{3}{4}$ size of the staminodes, white, drying brown, sometimes reddish. *Ovary* fusiform, c. 0.8 (-1.5) x 0.3-0.5 mm, white, glabrous, drying brown. Receptacular tube inside glabrous. *Fruit* ovoid to fusiform, 4.4-11 x 2.3-3.5 mm, green to honey-green, drying green or honey-yellow to reddish, often having 6 prominent longitudinal veins or a glandular ring on top. *Stone* ovoid to narrow-ovoid, 2.5-4.6 x 1.5-2.5 mm, green-brown to dark-brown. (Figs 4-7).

Distribution (Map 2)

Endemic to Australia, occurring in all States except Northern Territory.

Flowering

Flowering throughout the year in Australia, but flowering season differs from State to State.

Note

Collections with flowers only from Queensland and South Australia are assumed to be *f. glabella* and *f. dispar* respectively as these are the only forms known to occur in these States.

Specimens examined—in flower only

WESTERN AUSTRALIA: *Cronin s.n.* (MEL 58713, MEL 58715). *Diels & Pritzel s.n.* (PERTH). *Drummond s.n.* (MEL 58368). *George 9253* (AD, PERTH). *Keighery 1573* (Kings Park, Perth); 1997 (Kings Park, Perth). *Kenneally 1091* (PERTH); 1242 (PERTH). *Muir s.n.* (MEL 58652). *Newbey 677* (PERTH). *Preiss 195* (G). *Royce 8437* (PERTH).

NEW SOUTH WALES: *Bernardi 12191* (G). *Blakely s.n.* (NSW 134981). *Caley s.n.* (BM). *Cheel s.n.* (NSW 134991). *Duryer 1088* (NSW). *Gilbert s.n.* (AD 966050478). *Ingram 2196* (NSW). *McGillivray 1561* (NSW). *Rodway 1047* (K, NSW); *s.n.* (NSW 134984). *White s.n.* (BRI 177484). Hawkesbury Agric. Coll., Richmond (NSW 134998).

VICTORIA: *Davis s.n.* (MEL 58382). *Gates s.n.* (MEL 58383). *Hart s.n.* (MEL 58374). *Johnson s.n.* (MEL 58446). *Meebold 2462* (M). *Morrison 22* (B, PRC); *s.n.* (B); *s.n.* (BRI 080420); *s.n.* (K). *Reader s.n.* (MEL 58387). *Walter 1721* (B); *s.n.* (MEL 58618). *Anon.*, nr St Kilda (NSW 134974).

TASMANIA: *Archer 529* (K, M). *Bowen s.n.* (MEL 58649). *Buiston s.n.* (MEL 58391). *Davis 7394* (NSW). *Gunn 7* (K). *Jackson 105* (HO). *Johnston 75* (MEL). *Maiden s.n.* (NSW 134979). *Rodway 7393* (NSW). *Anon* (?R.C. Gunn) 27 (HO); 212 (MEL 58412).

Key to forms

1. Petals pubescent inside; two callosities distally on petals, scarious margin of sepals and floral bracts usually yellow (dried) (W. A. forma) 1d. *f. bicallosa*
 Petals glabrous inside; scarious margin of sepals and floral bracts white (dried) 2
2. Fruit with conspicuous glandular ring (yellow) on top (W.A. forma) 1c. *f. casuarinae*
 Fruit without glandular ring 3
3. Fruit ovoid, floral bracts almost horizontal 1a. *f. glabella*
 Fruit pyriform to fusiform, base clasped by almost vertical floral bracts 1b. *f. dispar*

Except for f. *bicallosa*, the forms can only be distinguished in fruit. See Table 2 for a summary of fruit dimensions of each form. *C. glabella* forma *bicallosa*, which is not indentifiable primarily on fruit characters, is not included in this table.

Table 2. Fruit dimensions (mm) in forms of *C. glabella*.

		W.A.	S.A.	Vict.	N.S.W.	Qld
f. <i>dispar</i>	length	7.5	6.0	5.0	5.5	—
	max.	10.9	7.9	8.5	6.3	—
width	aver.	2.8	2.5	2.3	2.5	—
	max.	3.7	3.3	3.3	2.9	—
f. <i>glabella</i>	length	6.2	—	4.5	4.4	4.9
	max.	7	—	5.5	5.1	5.5
width	aver.	3.5	—	3.1	3.0	3.1
	max.	3.7	—	3.5	3.6	3.5
f. <i>casuarinae</i>	length	5.5	—	—	—	—
	max.	7.7	—	—	—	—
width	aver.	3	—	—	—	—
	max.	3.5	—	—	—	—

1a. *Cassytha glabella* forma *glabella*

Flowers ovoid, 1.3-2.5 mm long; *sepals* and floral bracts with scarious always white margins. Fruit ovoid to globular, (4-) 4.5-5 (-5.5) x (2.7-) 3 (-3.7) mm (dried), green or yellowish to orange-red, drying green, smooth. Longitudinal veins hardly visible. Fruit sessile on the floral bracts, which spread more or less horizontally. Stone deep green-brown, ovoid, 3-3.5 x c. 2.5 mm. (Fig. 4.)

Distribution (Map 2)

Occurs as the only form of *C. glabella* in Queensland, dominant in New South Wales, common in eastern Victoria and occurs in Tasmania. In W. Australia is known from few localities.

Flowering

Flowers from Feb.-July in Queensland, from June-Oct. in Victoria; throughout the year in Tasmania; fruit maturation takes 2-3 months.

Notes

Collections from Queensland in flower are all believed to belong to forma *glabella*, as this is the only form known to occur there. However, in the absence of fruits from some specimens, their identification is not possible.

Specimens examined

WESTERN AUSTRALIA: Broadbent 149 (BM). Chinnock 3206 (AD, CANB, NSW, PERTH). Eichler 21112 (AD, PERTH). Hnatiuk 761273 (PERTH).

QUEENSLAND: Coveny 2000 (BRI). Dowling 4 (BRI). Eames s.n. (BRI 177486). Gittins 899 (BRI). Harold C075 (BRI). Henderson 592 (BRI, MEL); 931 (BRI). Hubbard 3937 (BRI, K). Hunt s.n. (K). Nash 24 (AD). Simmonds 427 (BRI). Specht 1448 (AD). White s.n. (BRI 177485); 7645 (BRI, NY). Field Nats (BRI 177491). Anon, Sunnybank (BRI 177487).

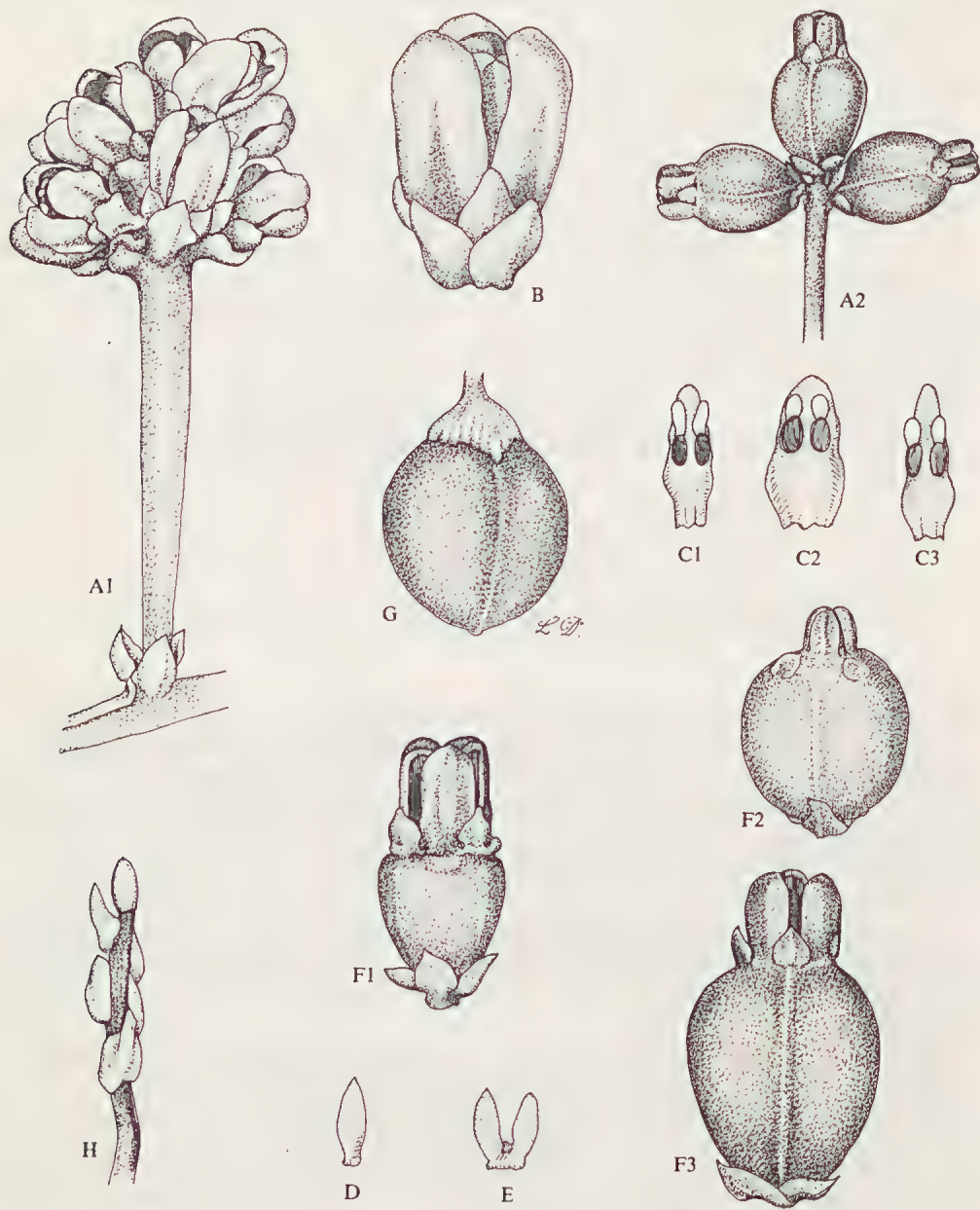


Fig. 4. *Cassytha glabella* f. *glabella*. A, inflorescence: A1, with flowers; A2, with fruits. B, flower and bracts. C, stamens, front view showing open loculi and upright flaps: C1, second whorl; C2, first whorl showing filament widened laterally; C3, third whorl. D, staminode. E, glands with base attached to receptacle. F, fruits: F1, young with almost horizontal verticillate bracts; F2, globose, showing bract and leathery perianth closing orifice; F3, obovate, showing almost horizontal verticillate bracts and perianth incompletely closing orifice. G, stone. H, young shoot with scale leaves.

NEW SOUTH WALES: *Blakely s.n.* (NSW 134993, 134994). *Boorman s.n.* (PR). *Camfield s.n.* (NSW 134980); *s.n.*, (G, NSW 134996, PERTH). *Carolin 3741, 3748, 8001* (SYD). *Cheel s.n.* (NSW 134998). *Coveny 1868, 4953* (NSW); *s.n.* (NSW 134985, 134986, 134998). *Evans s.n.* (CANB 3774, SYD). *Ford s.n.* (NSW 134992). *Fraser s.n.* (NSW 134987). *Gulliver s.n.* (MEL 58370). *Hamilton s.n.* (NSW 134995). *Ingram 3442* (NSW); *s.n.* (NSW). *Johnson 251* (NSW). *Lightgow 127* (NSW). *McGillivray 2039A* (NSW). *McKee s.n.* (SYD). *Rodway 7399* (K, NSW). *Salasoo 3741* (NSW). *Souer s.n.* (MEL 58381). *Wilcox s.n.* (MEL 58737). *Wilson 545* (NSW).

VICTORIA: *Aston 4, 6* (MEL). *Beauglehole 31205, 31279, 31519, 31570, 31676, 32637, 33037, 33486, 33963* (AD, BEAUGLEHOLE). *Cullimore 62* (MEL). *Hart 10* (MEL); *s.n.* (MEL 58442). *Morrison 1550* (K); *s.n.* (BM). *Pitcher s.n.* (MEL 58376).

TASMANIA: *Buften 24* (MEL). *Davis 1264* (MEL). *Stuart s.n.* (MEL 50408). *Anon (?R.C. Gunn) 56* (MEL 58409, 58410).

AUSTRALIA: *L'hotsky s.n.* (OXF). *Verreaux s.n.* (OXF, NY). *Anon*, Nov. Holl. (PRC).

1b. ***Cassytha glabella* forma *dispar*** (Schltdl.) J.Z. Weber, stat & comb. nov.

C. dispar Schltdl., *Linnaea* 20: 578 (1847).

Type: *H. Behr 45*, An sandigen Orten, Sud-Australien, a. 1847, (HAL 42852, holo.).

C. micrantha Meisn. in DC., *Prod.* 15: 256 (1864), pro parte, excl. lectotype, quoad spec. *J. Drummond 149*, "Swan River", (Western Australia), (K, syntype).

Flowers ovoid or obovoid 1.3-2.5 mm long; *sepals* and floral bracts with scarious always white margins. *Fruit* fusiform to narrow-ovoid, (5-) 6-7 (-10.9) x (1.5-) 2.5 (-3.7) mm, pale-green or yellow to orange-red, dried young fruit very dark, mature golden to honey-yellow with lighter coloured, quite prominent longitudinal veins continuing into the perianth segments; basal portion narrowed to a stalk clasped by the almost vertical floral bracts. *Stone* green-brown to dark-brown, narrowly ovoid, 2.6-4.6 x 1.5-2.5 mm, at least 1/3 longer than wide. (Fig. 5.)

Distribution (Map 2)

Common in southern Western Australia, rare in New South Wales (Two Fold Bay), frequent in Victoria and Tasmania; in South Australia the only form known to occur.

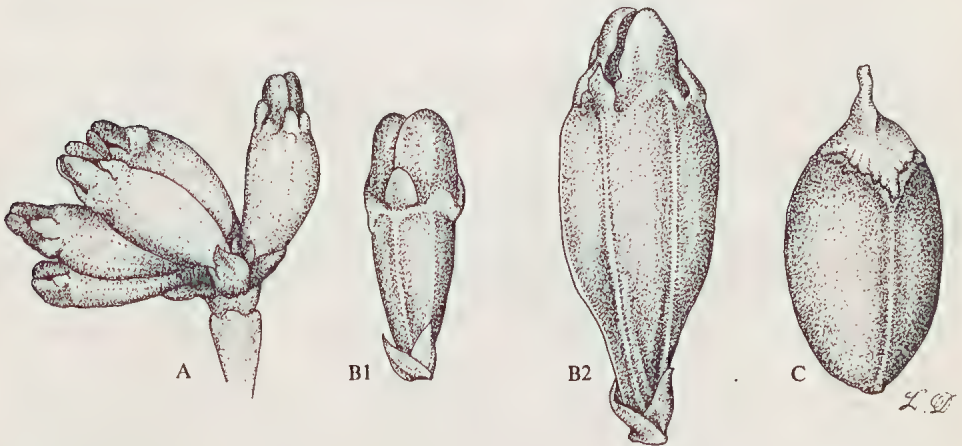


Fig. 5. *Cassytha glabella* f. *dispar*. A, fruits in head on tip of peduncle. B, fruits showing verticillate bracts and perianth: B1, young fruit; B2, mature fruit, showing faint vertical ribs (dried). C, stone with basal portion of style.

Similarities

Differs from *f. glabella* in the narrower and longer fruit, of which the basal portion of the receptacle rapidly expands at an early stage, elevating the perianth on a pedicel-like structure, which becomes wrinkled in the dried state, and in the floral bracts which clasp the stalk-like extension of the fruit and are almost vertical. Some collections from scattered places in South Australia have an almost globose fruit, but always elevated by a stalk above the floral rosette.

Specimens examined

WESTERN AUSTRALIA: *Aplin* 1926 (PERTH). *Batt* s.n. (MEL 58428). *Beauglehole* 12121 (BEAUGLEHOLE); 49200, 49293 (AD, BEAUGLEHOLE). *Chinnock* 3265 (A, AD, PERTH). *Cleland* s.n. (AD 97807196). *Eichler* 15855 (AD, G, PERTH); 19982, 20157 (AD, PERTH); 21139 (AD, NY, PERTH). *Fitzgerald* s.n. (NSW 135109). *Gardner* 726, 1668 (PERTH). *George* 10015 (PERTH). *Green* 455 (PERTH). *Haegi* 952 (AD, Z). *Helms* s.n. (AD 96633217, 97424459, MEL 58429, CANB, NSW 134977). *Hnatiuk* 760588 (PERTH). *Jackson* 1305 (AD, OXF, PERTH). *Keighery* 140 (PERTH); 1172, 1608 (KINGS PARK); 1593 (PERTH, KINGS PARK). *Kenneally* 1267 (PERTH); 1284 (AD, PERTH). *Koch* 2574 (BRI); 2349 (NSW); 3029 (MEL, NSW, PERTH). *Kuchel* 1600 (AD). *McFarland* 1258 (AD, PERTH). *Meebold* 10074 (M). *Merrall* s.n. (MEL 58664). *Morrison* 8432 (K); s.n. (BRI 158237). *Mueller* s.n. (MEL 58438). *Orchard* 1613 (AD, PERTH). *Paust* 599, 601, 974, 1075 (PERTH). *Pulley* 1372 (CANB). *Royce* 1265, 8092, 8983 (PERTH). *Salasoo* 353 (NSW). *Short* 639 (AD, MEL). *Smith* s.n. (K). *Story* s.n. (MEL 58654). *Waye* s.n. (MEL 58434). *Weber* 5228 (AD, BM, K). *Whibley* 5358 (AD, PERTH). *Wilson* 3242 (AD, MEL, PERTH); 8054 (AD, PERTH); 10085 (PERTH). *Anon*, Darkin (MEL 58416).

NEW SOUTH WALES: *Beauglehole* 33677 (AD, BEAUGLEHOLE, NSW). *Boorman* s.n. (G). *Morrison* s.n. (G). *Mueller* s.n. (MEL 58433, 58437).

VICTORIA: *Adamson* s.n. (K). *Aston* 613, 985, 1033 (MEL). *Beauglehole* 25214, 30814, 32225, 33500, 34150 (AD, BEAUGLEHOLE). *Bissil* 1 (MEL). *Carrick* 3319 (AD, CANB, MEL). *C.N. (?Nees)* s.n. (MEL 58378). *Davies* 120 (AD). *French* s.n. (MEL 58630). *Hart* 3, 5 (MEL); s.n. (MEL 58397, 58398, 58444). *Harvey* 7 (TCD). *Luehman* s.n. (BRI 176708, MEL 58731). *Morrison* 1552 (K); 1553, 1557 (BM, K); 1559 (PERTH); 1560 (BRI, MEL); 1561 (NSW); 1562 (CANB); 2068 (AD, K, M, MEL); 2071 (AD, NSW); 2072 (NSW, PERTH); 3049 (MEL); 5073 (CANB, PERTH); s.n. (BM, CANB 50232, G, M, MEL 58392, NSW 134976, PERTH). *Mueller* s.n. (K, MEL 58379, 58385). *Reader* 23, 26 (MEL); s.n. (MEL 58386, 58388, 58389). *Spence* s.n. (MEL 58686). *Studer* s.n. (G). *Sullivan* 8a (MEL). *Walter* s.n. (MEL 58621, NSW). *Weber* 3720 (AD, P). *Whibley* 3372 (AD). *Williamson* s.n. (MEL 58337, NSW 134972). *Anon*, St Kilda & East Brighton (NSW 135129); Robertson (K); nr Stawell (MEL 58626).

TASMANIA: *Archer* s.n. (K). *Atkinson* 123 (HO). *Barker* 902 (AD). *Buften* 11 (MEL). *Caley* s.n. (BM). *Chinnock* 2253 (AD, HO). *Comber* 1388, 2339 (K). *Gunn* 27 (BM, K, NSW, HO); s.n. (TCD). *Hooker* s.n. (MEL 58421, NY). *Milligan* s.n. (BM). *Rodway* s.n. (HO 7457, 7461). *Sharman* s.n. (HO 7459). *Somerville* s.n. (HO 7455, 7465). *Anon* 605 (MEL 58411).

SOUTH AUSTRALIA: *Alcock* 2909, 4607 (AD). *Ashby* 697 (AD). *Babbage* s.n. (MEL 58436). *Barker* 1798 (AD, BRI, OSH, TRN, WU). *Bates* s.n. (AD 97615025, 97623147, 9772580). *Beek* 110 (AD); 141 (AD, G, H). *Blaylock* 432, 1656 (AD). *Black* s.n. (AD 97424473-7). *Booth* 9 (AD, K, L, M, UC, W). *Browne* s.n. (MEL 58623, 58625). *Carrick* 3495 (AD, K, TCD). *Carrodus* s.n. (AD 96212146). *Chigwidden* s.n. (ADW 42360). *Cleland* s.n. (AD 96609621, 97307150, 97424461). *Cooper* s.n. (AD 96228338). *Copley* 2563, 4338 (AD). *Crocker* s.n. (ADW 4596). *Dodson* 102 (AD). *Donner* 228 (AD, BRI); 1176, 5515 (AD); 4752 (AD, K). *Eardley* 5001 (ADW); s.n. (ADW 1094, 6091). *Eichler* 12147 (AD, NY); 12173 (AD, L); 14254 (AD, CHR, MEL); 14515 (AD); 16301 (AD, CANB); 18512 (AD, UC). *Fieldhouse* 47 (AD). *Grivell* 4 (AD); s.n. (AD 96927291). *Haegi* 324, 427 (AD). *Heddle* KCP58 (AD). *Hubbard* 8561 (K). *Hunt* 519 (AD). *Hussey* s.n. (MEL 58431, 62375). *Ising* s.n. (AD 96219255, 96321063, 966021428, 966021433, 966021445, 966021447, 966071504, 97006138). *E. Jackson* 7, 1638 (AD). *I. Jackson* 515, 562, 965, 974, 980, 1007, 1017 (AD). *Kuchel* 1247, 2276, 2710 (AD). *Lea* s.n. (K, partly). *Lothian* 1245 (AD). *Maiden* s.n. (NSW 134978). *Menzel* s.n. (AD 97424456-7). *Mueller* s.n. (MEL 58417-8, 58424). *Nash* s.n. (AD 97027076, 9734004). *Orchard* 151a (AD). *Purdie* 179a (AD). *Rendle* s.n. (K, partly). *Salasoo* 1667 (NSW). *Salisbury* s.n. (OXF). *Sealy* s.n. (MEL 58413). *Sexton* s.n. (AD 96924049). *Shaw* s.n. (AD 97244291). *Southcott* s.n. (AD 97330110). *Specht* 31 (AD); s.n. (AD 96109495). *Spooner* 365, 811, 910, 4159, 4491 (AD). *Symon* 1609, 6407, 8551 (ADW). *Tate* s.n. (AD 97424455, 97424463). *Tepper* s.n. (MEL 58629-30). *Weber* 643, 1795, 1866, 2020, 3709, 3809, 3830, 4032, 4158, 4284, 4408, 4412, 4458, 5232 (AD). *West* 2237, 2418 (AD). *Wheeler* 340 (AD). *Whibley* 40, 1393, 1476, 1575, 2246 (AD). *White* s.n. (AD 97617077, 97601978). *Wilkinson* s.n. (ADW 18351). *Wilson* 1233 (AD); 1301 (AD, MEL, PERTH); 1431 (AD, HO); 1929 (AD, CANB, NT); 2808 (AD, LY). *Anon*, Mt Compass (AD 966070668); Onkarparinga (MEL 58419); Pt Lincoln (MEL 58415).

AUSTRALIA: *Mueller* s.n. (MEL 58426, NY).

1c. *Cassytha glabella* forma *casuarinae* (Nees) J.Z. Weber, stat & comb. nov.

C. casuarinae Nees in Lehmann, Pl. Preiss. 619 (1845); Meisn. in DC., Prod. 15: 253 (1864).

Type: *J. Drummond* 64, Western Australia (MEL 58369 neo., K, NY, iso.).

C. digitata Nees in Lehmann, Pl. Preiss. 620 (1845); Meisn. in DC., Prod. 15: 257 (1864).

Type: *L. Preiss* 1626, Princess Royal Harbour, (Western Australia), Dec. 1840, (MEL 58579, syn.).

C. microcephala Meisn. in DC., Prod. 15: 253 (1864), *pro parte* quoad spec.: *W. H. Harvey* 4, King George's Sound, (Western Australia), Jan., Febr. 1854 (NY, TCD syntype); *W. H. Harvey* 8, King George's Sound, (Western Australia), Jan., Febr. 1854 (NY, TCD syntype).

C. racemosa non Nees, sensu Benth., Fl. Austral. 5: 312 (1870), p.p. as to syn. *C. digitata* Nees.

Flowers ovoid 1.3-2.5 mm long, *sepals* with white scarious margins turning yellow and gland-like in fruit later. *Fruit* turbinate to campanulate, (4.5-) 5-5.5 (-7.7) x (2.5-) 3 (-3.5) mm, (?green), drying golden-brown finely dotted with glands; conspicuous yellow glandular ring in form of plate surmounting the fruit under perianth segments, drying yellow to brown; longitudinal veins hardly visible. *Fruit* sessile or stalked on floral rosette which clasps the base. *Stone* dark brown, ovoid and 2.5-3 x c. 2 mm, to globose and c. 2 mm in diameter. (Fig. 6.)

Distribution (Map 2)

Collections were made near the southern coast of Western Australia and Swan River.

Notes

The type specimen listed by Nees was *L. Preiss* 1624, York District, Western Australia, March, 1840, but this was probably destroyed in BONN or B and no duplicate has been located. The type description agrees with this form. Meisner (1864) cited, among others, *J. Drummond* 64 and *L. Preiss* 1624. On the assumption that he had examined both and found them in close agreement, the Drummond specimen has been selected as a neotype.

Similarities

Differs from f. *glabella* and f. *dispar* in having a yellow glandular ring apparent from early stages of fruit development and in the sepals turning yellow.

Specimens examined

WESTERN AUSTRALIA: *Ashby* 5332 (AD). *Davies* 469 (AD). *Jackson* s.n. (CANB, NSW, PERTH). *Koch* 2574 (MEL 58439-40). *Kenneally* 1272 (AD, PERTH). *Meebold* 11069 (M). *Morrison* 7405 (K). *Mueller* s.n. (MEL 58637). *Pritzel* 173, (K, NSW). *Royce* 4225, 4228 (PERTH). *Sewell* s.n. (MEL 58635, 58648). *Whibley* 5413 (AD, PERTH). *Wilson* 4362 (PERTH).

1d. *Cassytha glabella* forma *bicallosa* J.Z. Weber, forma nov.

Caulis c. 0.6 mm crassus; *pedunculus* c. 10 mm longus; *flores* c. 6 in capitulo aggregati; *floris* bracteae verticillatae, margine *sepalorum* flavo scarioso; *petala* obovata, 2-3 mm longa, distaliter bicallosa, callis ellipsoideis, c. 0.5 mm longus; *stamina* ordinis primis lata; *stamina* ordinis secundis et tertiis oblanceolata, similia; *staminodia* subulata, 0.4-0.5 mm longa; *glandulae* breviores.

Type: (? Anon. per) *A. Oldfield* s.n., Oolingurru (Oolingurrah), (Murchison River, Western Australia), (MEL 58432, holo.; K, iso.).

Stem 0.5-0.7 mm thick, yellow-brown (in sicco). Peduncles to 10 mm long, c. 0.5 mm thick, narrower basally, mostly 6 flowered in a capitate cluster. Subtending bract triangular, 0.5-2 x c. 0.7 mm, acute, basifixed, glabrous, brown (in sicco); bracteoles similar, smaller. *Flower* obovoid, (1.9-) 2.4-3 (-3.2) x (1.2-) 1.4 (-1.6) mm. Floral bracts almost erect; bract c. 1.5 x c. 1 mm, scarious margin usually yellow; bracteoles similar, smaller. *Sepals* c. 1 mm long, usually with narrow scarious margin (in sicco); *petals* obovate, 1.5-3 x 0.6-1 mm, glabrous outside, white pubescent inside, indumentum short,

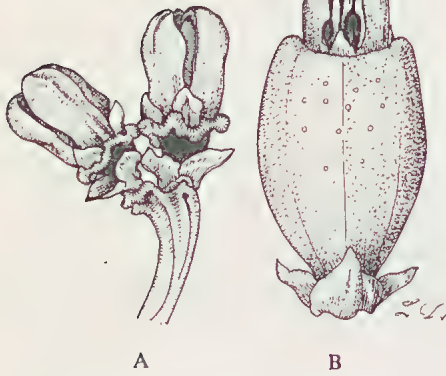


Fig. 6. *Cassytha glabella* f. *casuarinae*. A, young fruits on peduncle, showing stressed glandular ring (dried) at base of perianth. B, mature fruit showing verticillate bracts and the glandular ring at base of perianth.



Fig. 7. *Cassytha glabella* f. *bicallosa*. A, flowers on the peduncle. B, flower showing verticillate bracts, stamens (in the middle) and callosities distally on the petals.

hairs several celled, slightly glandular; distally bearing two internal callosities 0.4-0.6 mm long, which may bulge on the outside, white, powdery-waxy inside. *Stamens* of the first whorl ovate, c. 2 x 0.5 mm, filament under cells wider than cells; stamens of the second whorl narrow-lanceolate, c. 2 x 0.3 mm, occasionally with hairs sprinkled dorsally; stamens of the third whorl narrow-lanceolate c. 1.8 x 0.3 mm. *Staminodes* subulate, 0.4-0.5 x c. 2 mm, glands similar, smaller for 1/3rd. *Receptacular tube* papillose pubescent inside. Fully developed *fruit* not seen. Young fruit spherical, apically with glandular ring. (Fig. 7.)

Distribution (Map 2)

Endemic to south-western Western Australia. Collections have been made near the mouth of the Murchison River, Claremont in the Lower Swan River, in the Swan District, Darling Range and Watheroo.

Similarities

Similarities with f. *glabella* in having a hemispherical sessile fruit, with f. *casuarinae* in having a yellow fleshy glandular ring but it differs from them in the petals being pubescent inside.

Specimens examined

WESTERN AUSTRALIA: *Cranfield* 1250 (PERTH). *Griffin* 1811 (PERTH). *Hnatiuk* 780058 (PERTH). *Keighery* 1997 (PERTH, KINGS PARK). *Pritzel* 173 (AD, BM, G, HBG).

2. *Cassytha micrantha* Meisn. in DC., Prod. Syst. nat. Regni veg. 15: 256 (1864).

Type: *W.H. Harvey* 1, King George's Sound, (Western Australia), Jan., Feb., 1854, (TCD, lecto.). (See notes.)

Stems glabrous golden-greenish (dried), (0.2-) 0.3-0.4 (-0.6) mm thick, haustoria 1-2 mm long, *leaves* narrow-ovate, c. 0.5 x 0.2 mm. *Inflorescence* usually a single stalked loose spike; peduncle (8-) 10-15 (-23) mm long, thickest in central portion, c. 0.5 mm thick, 10-15 flowered or more, supported by a narrow-lanceolate bract 0.5-1 mm long and two

similar bracteoles. *Flowers* globular, sessile, conspicuously spirally arranged in 1/3 phyllotaxis, sometimes 1 is remote below, may be aborted and then bracts present only. Floral bracts verticillate, conspicuous; bract triangular, acute, c. 0.7 x 0.3 mm, glabrous, honey coloured; bracteoles similar but narrower, c. 0.5 mm long. Basal flowers c. 0.7 mm, apical c. 0.4 mm, developing acropetally; *sepals* triangular-ovate, 0.3-0.4 x 0.2-0.3 mm long, honey coloured; *petals* ovate, mucronulate, incurved to hooded, to c. 0.6 mm long and wide, golden-brown (dried), darker than sepals. Fertile *stamens* 9, c. 0.5 mm long,

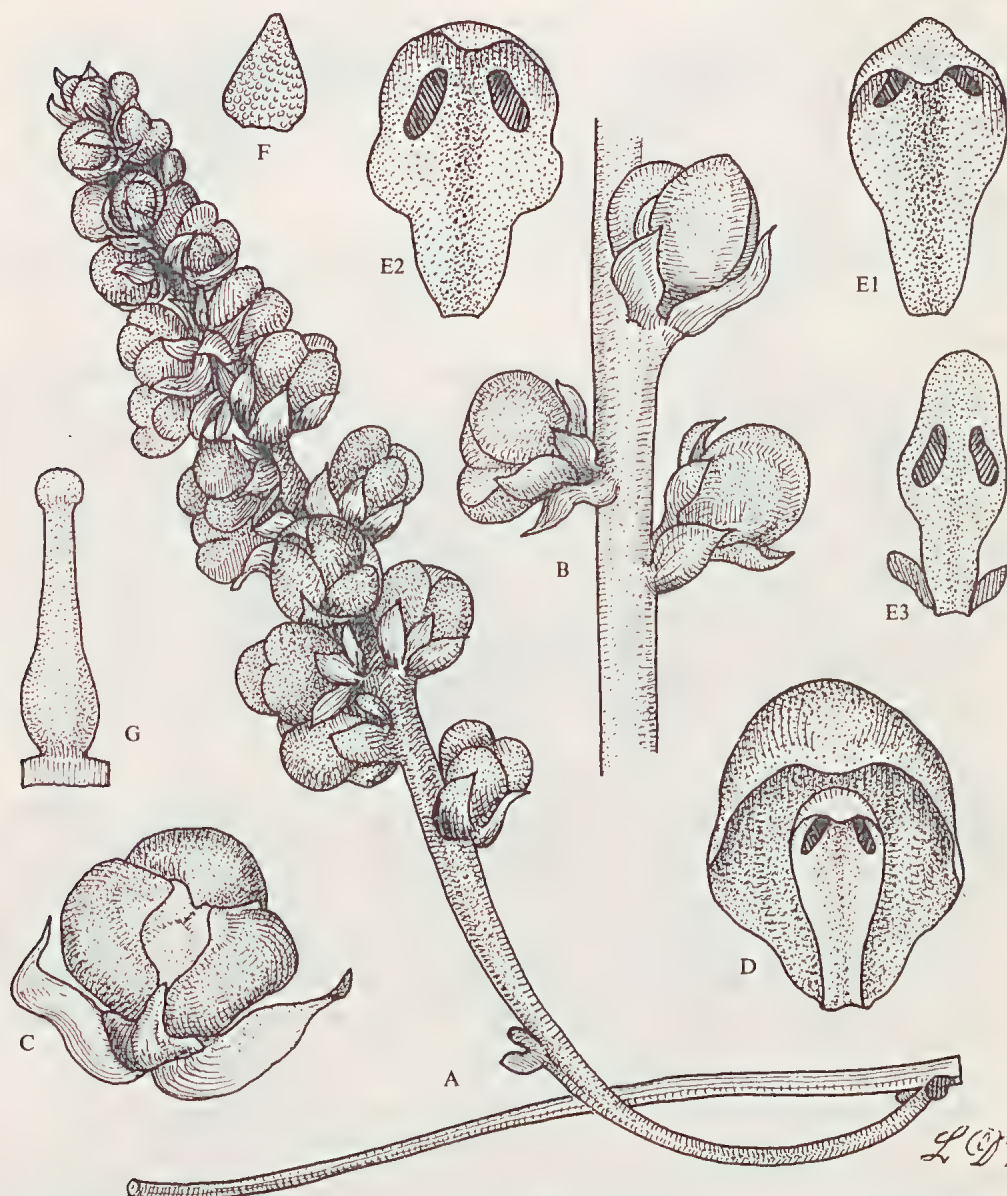


Fig. 8. *Cassytha micrantha*. A, stem and inflorescence in flower. B, flowers showing spiral arrangement in 1/3 phyllotaxy. C, flower with bracts. D, petal from inside, with dorsi-basally adnate stamen of the second whorl. E, stamens, front view showing loculi: E1, second whorl; E2, first whorl, showing laterally expanded filament; E3, third whorl, with two glands basally. F, staminode. G, ovary.

white, turning brown; stamens of the first whorl spatulate, 0.35-0.4 mm across, filament widened just below cells, narrowed at base; stamens of the second whorl oblong-spatulate, c. 0.3 mm across, cells wider than filament, tip blunt, inflexed; stamens of the third whorl fusiform, c. 0.25 mm across, cells wider than filament and placed centrally, tip obtuse, straight. Staminodia triangular-pyramidal, c. 0.2 x 0.1 mm, brown (dried); gland ovoid, c. 0.1 mm long, brown (dried). *Ovary* fusiform, c. 0.5 x 0.2 mm, honey-coloured (dried). Receptacular tube glabrous outside and inside. *Fruit* not seen. (Fig. 8.)

Distribution (Map 3)

Endemic to the southern coast of Western Australia where it is known from two collections, one east of Esperance, Thistle Cove (34° 01' S, 122° 12' E), *A.S. George s.n.*, 21.i.1966 (PERTH) and *W.H. Harvey 1*, type collection from King George's Sound.

Flowering

Flowers Jan.-Feb.

Similarities

Similar to *C. glabella*, but differs in the loosely spiral arranged spike and smaller globular flowers to 0.7 mm long, ripening acropetally. This is the most slender-stemmed representative of the genus.

Notes

In his description of *C. micrantha*, Meisner (1864) cited three Drummond collections and one of Harvey's, all from Western Australia. The only duplicates located are in K (*Drummond 61, 149, 152*), MEL (*Drummond 61*), NY (*Drummond 152*) and TCD (*Harvey 1*). *Drummond 149* is fertile and identifiable as *C. glabella* f. *dispar*. The other Drummond specimens are sterile but conspecific with his 149. The Harvey specimen is fertile and of a different species. The Drummond specimens at Kew were identified in Meisner's hand as *C. micrantha* but his doubt of their identification is indicated on numbers 61 and 149 by a question mark. The Harvey specimen was not annotated by Meisner. Meisner distinguished between *C. glabella* and *C. micrantha*, as is evident by his placing them in section *Capitatae* and *Spicatae* respectively, largely on inflorescence characters. On these grounds the Harvey specimen, with a very distinct elongate spike, is selected as the lectotype rather than the sterile or capitate collections of Drummond.

3. *Cassythia pedicellosa* J.Z. Weber, sp. nov.

Plant glabra; *caulis* tenuis, (0.3-) 0.4-0.5 (-0.7) mm crassus, ramosissimus, obsolete striatus; haustoria elliptica, vix 1 mm longa; *folia* squamiformia, ovata, c. 0.5 mm longa. Pedunculi solitarii, 8-20 mm longi, c. 0.4 mm crassi, 3-5 floribus (vel plus), suffulti bractea una et bracteolis binis. Floris bractee in planitiebus duobus, bractea basem pedicelli amplexens, bracteolae $\frac{3}{4}$ supra basem pedicelli amplexentes. *Flores* globosi, c. 1 mm in diametro, distincte pedicellati; *sepala* triangularia; *petala* ovata, subacuta, c. 0.9 x 0.8 mm. *Stamina* perfecta 9; stamina ordinis primi cordata, rostellata, introrsa; secundi ordinis obcordata, introrsa; stamina ordinis tertii obcordata, extrorsa; staminodia ovata, c. 0.1 mm longa, opposita staminibus ordinis primi; glandulae geminatae, quam staminodia breviora, stamina ordinis tertii amplexentes. *Ovarium* subglobosum; stylus subulatus; stigma parva, globosa. *Fructus* ovoideus, verrucis crassius superpositus, tubo receptaculo graduatim angustato in pedicellum. *Caryopsis* subrotunda, c. 2.5 x 2.3 mm. ✓

— *Type*: Rodway (? L.), s.n. (1892), Derwent, Tasmania. (MEL 58390, holo.).

Plant glabrous; *stem* (0.3-) 0.4-0.5 (-0.7) mm thick, (golden-reddish to brown in sicco); haustoria elliptical, under 1 mm long; *leaves* ovate, c. 0.5 mm long. *Inflorescence* single; flowers in a stalked loose cluster, supported by a triangular, acute bract and two bracteoles, c. 1 x 0.7 mm. Peduncle 8-20 mm long, c. 0.4 mm thick, 3-5 (? more) flowered. Floral bracts in two planes; bract ovate to triangular, subacute, c. 0.8 x 0.5 mm basally clasping the pedicel; bracteoles remote, triangular, subacute c. 0.4 x 0.3 mm, clasping the pedicel in the upper 2/3rd. *Flowers* globular, c. 1 x 1 mm, on a 1 mm or slightly longer

pedicel, c. 0.3 mm thick, becoming thicker to 0.5 mm in fruit; receptacular tube fusiform, gradually narrowing into pedicel; *sepals* triangular, subacute, c. 0.7 x 0.6 mm; *petals* ovate, subacute, c. 0.9 x 0.8 mm, slightly hooded, golden-brown (dried). Fertile *stamens* 9; stamens of the first whorl obcordate, c. 0.8 x 0.4 mm, filament not expanded into vellum; stamens of the second whorl cordate, slightly beaked, c. 0.7 x 0.4 mm; stamens of the third whorl obcordate, c. 0.6 x 0.4 mm; staminodes ovoid, c. 0.1 mm long, glands $\frac{3}{4}$ of size of staminode. *Ovary* c. 0.9 x 0.3 mm (dried). Receptacular tube glabrous

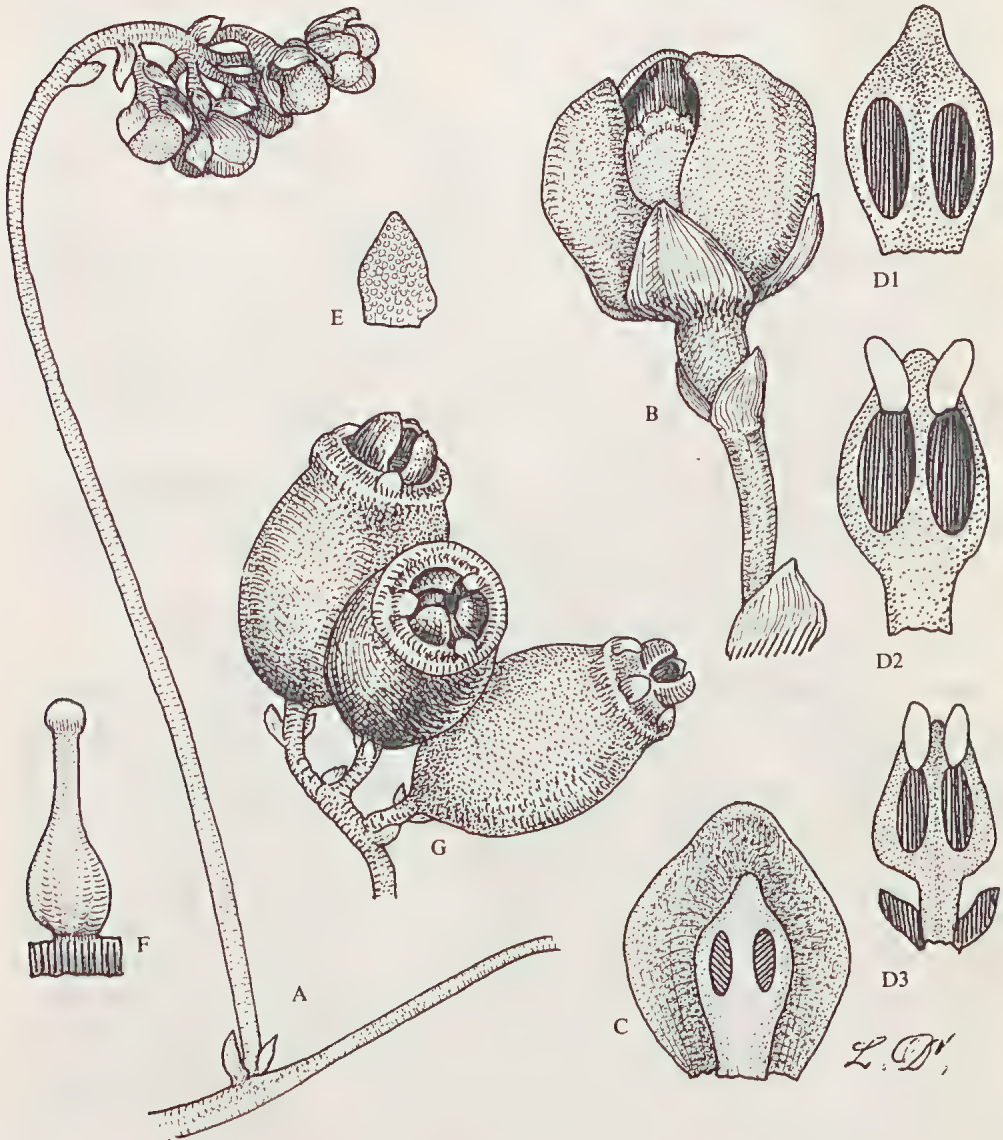


Fig. 9. *Cassytha pedicellosa*. A, stem and inflorescence in flower. B, flower, showing pedicel with basal bract and remote higher bracteoles flanking pedicel. C, petal, from inside with dorsi-basally attached stamen of the second whorl. D, stamens, front view showing loculi: D1, second whorl; D2, first whorl, showing upright flap; D3, third whorl, showing upright flap and two basal glands. E, staminode. F, ovary. G, fruits, showing pedicels attached to the peduncle and the glandular ring apically encircling the perianth.

inside. *Fruit* ovoid, glabrous, 4.2-4.5 x 2.5-3 mm, dark red-brown, longitudinally striate with darker lines, surmounted by conspicuous verrucae in the form of a thick plate (black dried); sphaeroid portion is carried on extended receptacular tube, which gradually attenuates into pedicel clasped by two bracteoles. *Stone* ovoid, dark-brown, c. 2.5 x 2.3 mm. (Fig. 9.)

Distribution (Map 4)

Endemic to Tasmania, known from a single collection made by Rodway from the Derwent (? River).

Flowering

The single collection is lacking the information on flowering.

Similarities

Differs from *C. glabella* in the conspicuous pedicel, floral bracts in two planes and dark brown fruit; from *C. micrantha* in the flowers clustered in a loose head.

Notes

It is the only glabrous Tasmanian species with pedicellate flowers and glandular ring on the fruit.

4. *Cassytha capillaris* Meisn. in DC., Prod. 15: 252 (1864); Hooker, Fl. Brit. India 5: 188 (1885); Pax in Engler & Prantl. Natürl. Pflanzenfam. 3(2): 124 (1891); Trimen, Handb. Fl. Ceylon 3: 455 (1895); Booberg, Bot. Jahrb. Syst. 66(1): 8 (1933); Allen, Journ. Arn. Arb. 23: 155 (1942).

Type: *J. Motley* 539, Bungarmassing, Borneo, 1857-8 (Herb. Hooker) (K, holo.).

C. glabella non R. Br. sensu Ewart & Davies, Fl. Northern Territory 113 (1917) quoad spec.: *R. Brown* (Bennett 3018), Islands of the Gulf of Carpentaria, a, b, c, e, f, g₁, g₂, g₃ (Sweers Island [islanda]), Nov.-Dec. 1802 (K-2 sheets); *F. Mueller*, Sturt's Creek, Jan.-May, 1856 (K).

C. strigosa Fitzg., Journ. R. Soc. W. Aust. 3: 143 (1918); Gardner, Enum. Pl. Austral. Occ. 44 (1931).

Type: *W.V. Fitzgerald* 817, Base of Mt Broome, Western Australia, May, 1905 (NSW, holo.).

C. tenuis Allen, Journ. Arn. Arb. 23: 155 (1942).

Type: *L.J. Brass* 6514, Mabaduan, Western Division, Papua, Apr. 1936 (A, holo., n.v., BRI 009564, iso.).

Stem (0.2-) 0.4-0.5 (-1.4) mm thick, drying green to reddish brown, young shoots glabrous or red pubescent, becoming glabrescent. *Haustoria* elliptic, mostly under 1 mm long. *Leaves* fleshy, ovate to triangular, c. 1 x 0.5 mm, glabrous or puberulent, commonly red ciliate. *Inflorescence* single, rarely paired spike; peduncles 2-18 x 0.3-0.5 mm, glabrous or with thick short strigose hairs or having long and dense retrorse or antrorse indumentum. Peduncles cylindrical or slightly clavate or attenuate when long, sometimes zig-zag, 3-10 flowered, flowers crowded distally or loose along peduncle. Supporting bract triangular to lanceolate, mostly ciliate, 0.5-1 mm long, usually less than 0.5 mm broad, bracteoles similar, narrower. *Flowers* sessile, globose, c. 1.2 mm across before expanding. Floral bracts verticillate; bract triangular, c. 1 x 1 mm, puberulent to glabrous, red ciliate; bracteoles similar, smaller. Receptacular tube pubescent or glabrous. *Sepals* triangular, c. 0.5 mm long and wide, mostly glabrous, red-ciliate. *Petals* ovate, bluntly acute, c. 1.1 x 1 mm, glabrous, greenish outside, whitish inside, sometimes slightly red tinted, some are bordered with a narrow dark rim (dried) which in fruit turns into a hyaline margin. Fertile *stamens* 9, white; stamens of the first whorl lanceolate to ovate, c. 0.7 x 0.3-0.6 mm, varying in the width of the filaments, which are narrower or wider than cells, sometimes laterally slightly pointed; stamens of the second whorl oblanceolate, c. 0.7 x 0.3 mm, upper portion inflexed, tip blunt; stamens of the third whorl obovate, c. 0.6 x 0.3 mm, cells obcordate, wider than filaments, tip blunt. *Staminodes* pyramidal, tip wedge shaped, c. 0.3 x 0.2 mm, white, occasionally with a

white apical gland; glands ovoid or obovoid, c. 0.2×0.15 mm, occasionally with a white apical gland. *Ovary* fusiform, glabrous, c. 0.9×0.4 mm (dried). Receptacular tube inside glabrous. *Fruit* ovoid, 4-6 \times 3-4 mm (dried), glabrous or pubescent, hairs adherent, vinaceous red, drying darker. *Stone* ovoid, c. 3×2.5 mm, dark red-black. (Fig. 10.)

Distribution (Map 5)

Occurs in Borneo, Buru (Boero), Ceylon, New Guinea, ? Timor and in northern Australia north of 24° latitude: in Western Australia from North West Cape eastwards through the Kimberley region; in Northern Territory through Arnhem Land entering deeply southwards in the arid region; in Queensland occurring on the Barkly Tableland and Cape York Peninsula.

Flowering

Flowers apparently all year round, depending on rain.

Similarities

Distribution of *C. capillaris* overlaps with *C. filiformis* and resemblance is quite remarkable in specimens resembling types of *C. strigosa* and *C. tenuis* which have elongate peduncles and loosely arranged flowers. In both species the young shoots and inflorescence may be pubescent to some degree and the petals are always glabrous. In *C. filiformis* the receptacular tube is always glabrous, as are the fruits which are regularly globular, green and drying black, while the fruits in *C. capillaris* are smaller, ovate and

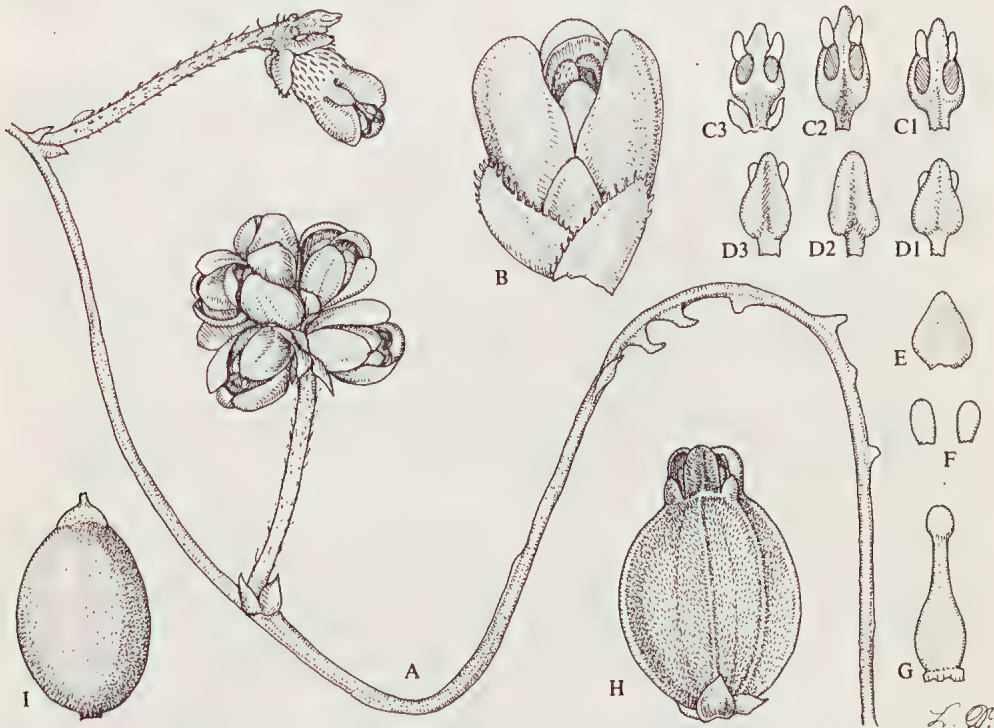


Fig. 10. *Cassytha capillaris*. A, habit drawing, stem with haustoria (which did not attach to the host) and two peduncles; upper peduncle with young fruit showing the strigose indumentum and lower peduncle with a head of flowers. B, flower with bracts. C, stamens in front view, showing open loculi and upright flaps: C1, first whorl; C2, second whorl; C3, third whorl with two basal glands. D, same stamens as in C, but in rear view. E, staminode. F, glands. G, ovary. H, mature fruit showing verticillate bracts basally, strigose hairs and perianth with closed orifice. I, stone.

red even when dry. The stem of *C. filiformis* is stouter and even in the least hairy forms scattered hairs are more frequent than in *C. capillaris*, which is almost glabrous, although glabrescent forms of *C. filiformis* occur in Queensland. Peduncles of *C. filiformis*, whether short or long, are never less than 0.5 mm thick, and those in *C. capillaris* are under 0.5 mm thick (dried). Petals of *C. filiformis* (dried) have a basal dark (blackish) triangle which continues on to receptacular tube, and is conspicuous in fruit, but has not been observed on *C. capillaris*. Some specimens have 5-10 flowers congested in a head on 5-10 mm long peduncles, resembling *C. glabella*, but the peduncle is irregularly covered with short and thick or long, soft scattered hairs, and the fruit is reddish and pubescent to glabrescent. Similarities with *C. ciliolata* show in the short peduncle and few flowers crowded distally, but these species differ in the petals which are pubescent in *C. ciliolata* and glabrous in *C. capillaris*.

Notes

The type specimen of *C. capillaris* has peduncles 7-8 mm long, slightly clavate (dried) and pubescent, with 6 or 7 flowers congested apically; the stamens are more or less subequal, the cells obcordate and wider than the filament, the fruits are ovate, dark red with scattered hairs. The type specimen of *C. strigosa* has peduncles 15-18 mm long, attenuate, with dense retrorse reddish indumentum, up to 10 loosely arranged flowers per spike, the filaments of the first staminal whorl expanded up to 0.5 mm and wider than the cells. The type of *C. tenuis* has shorter peduncles 5-10 mm long, attenuate with antrorse reddish indumentum, only three flowers arranged loosely in the head, and the filaments of the first whorl up to 0.3 mm broad and narrower than the cells. All types have similar fruits.

The five characters, on which the types of *C. capillaris*, *C. strigosa* and *C. tenuis* could be segregated, are not considered to provide a basis for recognizing three species. The form of inflorescence, occurring in the type of *C. strigosa*, is very unusual. The author has seen only one other collection, from Western Australia (*P.G. Wilson 11457*), which resembles the type in this character, but on the same specimen some peduncles are shorter with few (-3) flowers, more closely resembling the type of *C. tenuis*. The stamens of this specimen are, however, closer to those of the type of *C. strigosa* (c. 0.4 mm wide). The breadth of filaments of the first whorl varies from c. 0.3-0.5 mm wide in other collections from tropical Australia and the width, not correlated with any other character, does not appear to be taxonomically significant within the complex.

A second related New Guinea collection seen by the author *Robbins 2392*, Roma road, Middle Sepik Plains, 9.ix.1959 (CANB 71263), has peduncles 5-10 mm long, up to 3 flowers gathered distally and narrow filaments, differing from the type of *C. tenuis* in that the indumentum is retrorse.

Most collections whether from close to the type locality of *C. strigosa* and *C. tenuis* or distant from them, including one from the Moluccas, *Alston 17040*, Namlea (3° 30' S, 126° 30' E), 2.ix.1954 (CANB 149625), have shorter peduncles (5-10 mm long) glabrescent or with retrorse indumentum, few flowers (-3), and the filaments of the second whorl varying from narrow to wide, and the fruits varying from pubescent to glabrescent. Some of the collections are very like the type of *C. capillaris*.

The description of *C. capillaris* given here covers the great variation seen in Australian and New Guinea specimens, the author being unable to correlate with geographical distribution any of the morphological characters distinguishing the types of *C. capillaris*, *C. strigosa* and *C. tenuis*. He is of the opinion that both the types *C. strigosa* and *C. tenuis* represent extreme forms of this species, and the name *C. capillaris* Meisn. is correct.

Specimens examined

WESTERN AUSTRALIA: *Beauglehole* 46905, 47059, 47866, 48249, 48801, 48894 (BEAUGLEHOLE); 51542, 51646, 52274, 52429, 52588, 52967, 52998, 53065, 53219, 53252, 53435, 53467, 53685, 53848, 53958, 54198 (AD, BEAUGLEHOLE). *Chinnock* 3850 (AD). *Eichler* 22212 (AD, CANB). *Fitzgerald* 164, 239, 748 (PERTH). *George* 3271, 3391, 6584 (PERTH). *Keighery* 774 (KINGS PARK). *Royce* 7130, 7152 (PERTH). *Symon* 10082 (AD, ADW); 11457 (ADW). *Weber* 4858 (AD, CANB, PERTH). *Wilson* 11413, 11457 (PERTH).

NORTHERN TERRITORY: *Basedow* 142 (K). *Beauglehole* 10622 (BEAUGLEHOLE, NT); 46268 (BEAUGLEHOLE); 50569, 50647, 50684, 50701, 50753, 50847, 54410, 58724, 59732 (AD, BEAUGLEHOLE). *Brown* (*Bennett* 3018) (BM). *Chippendale* s.n. (AD 95952131, CANB 74502, MEL 58357, NSW, NT 4291). *Edward* s.n. (ADW 23305). *Henshall* 1903 (NT). *Latz* 205 (AD, MEL, NT). *Lazarides & Adams* 164 (CANB, NSW). *Martin* s.n. (NSW 135221). *Must* 365 (AD, MEL, NT). *Mueller* s.n. (K). *Symon* 7720 (ADW). *Schomburgk* 132 (K).

QUEENSLAND: *Brown* (*Bennett* 3018) (BM). *Everist* 3291 (BRI, CANB). *Lavery* 115 (BRI). *Persietz* 63 (MEL). *Smith* 129, 12526 (BRI).

BURU (BOUERO): *Alston* 17040 (CANB).

NEW GUINEA: *Robbins* 2392 (CANB).

SRI LANKA: *Ferguson* s.n. (MEL 62328).

5. *Cassytha flava* Nees in Lehmann, Pl. Preiss. 1: 620 (1845); Meisn. in DC., Prod. Syst. nat. Regni veg. 15: 255 (1864); Benth., Fl. Aust. 5: 311 (1870); F. Muell., Syst. Census Austral. Pl. 4 (1882); F. Muell., Sec. Syst. Census Austral. Pl. 7 (1889); Gardner, Enum. Plant. Australe Occid. 44 (1931); Blackall & Grieve, How to know Western Australian Wildflowers I: 168 (1954).

Type: *L. Preiss* 1622, Fremantle, (Western Australia), Jan. 1839 (MEL 58361, lecto.; MEL 58362 & MEL 58363 iso-lecto.). (Lectotypified here.)

Stem filiform, (-0.2) 0.6 (-1.1) mm thick, grey-golden, diffuse-tomentose at first, becoming glabrescent later. Some hairs to 1 mm long, irregularly twisted and tinted red. *Haustoria* irregular in size and shape, sometimes stalked, more or less 1 mm across. *Scaly leaves* ovate, 0.5-1 x 0.3-0.6 mm fleshy, golden-brown (dried), retrorse-pubescent, hairs scattered. *Inflorescence* mostly solitary, rarely paired; bract narrowly lanceolate, leathery (dried), acute, 1-3 x c. 0.5 mm, covered with long scattered hairs, ciliate, glabrous beneath; bracteoles similar, smaller. *Peduncles* (3-) 12-18 (-32) x 0.2-0.5 mm narrower basally; long peduncles many-flowered, with long diffuse hairs; short peduncles few-flowered, with short retrorse hairs. *Flowers* 5-15, mostly in a head, sometimes one remote lower on the peduncle, subtended by verticillate floral bracts; bract ovate, acute, 1-1.5 x 0.5-0.8 mm, brown, leathery (dried), white-pubescent, ciliate, protruding among the flowers; bracteoles similar but about 1/3 as large. *Flowers* yellow, globular and c. 1 mm across before opening, rotate later, white-pubescent. *Sepals* when alive ovate, 0.5-1 mm x c. 0.5 mm, pubescent, yellow, glabrous inside, drying triangular, brown, c. 0.5 x 0.5 mm, thick-leathery. *Petals* ovate, subacute, 0.8-1.5 x 0.7-1 mm, pubescent outside, yellow, glabrous or slightly pubescent inside, remaining yellow when dried even on the fruit. *Receptacular tube* very short, yellow, pubescent. *Nine stamens* fertile, brown, triangular; stamens of the first whorl slightly wider, up to 0.6 mm, puberulent on the back; stamens of the second c. 0.7 x 0.5 mm, with thick short filaments sometimes pubescent on back; stamens of the third whorl ovate, 0.6 x 0.4 mm, reflexed, glabrous. *Staminodes* pyramidal, c. 0.3 x 0.3 mm, pubescent, tipped with oblique fleshy glabrous white glands which dry dark; glands ovoid, c. 0.2 x 0.15 mm, glabrous, not tipped with a gland. *Ovary* fusiform 1-1.5 x 0.5 mm, pubescent in upper half which protrudes from the pubescent receptacular tube. *Fruit* globular, grey, c. 4 mm across, densely white-pubescent; putamen globular, c. 3 mm across, black. (Fig. 11.)

Distribution (Map 6)

Endemic to Australia. Occurs in south-western Western Australia.

Flowering

Flowering probably all the year round, but fruits have only been collected from October to December.

Notes

The indumentum may vary from heavily villous to glabrescent; the indumentum is restricted to strigose hairs on top of the peduncle and the floral bracts and the sepals are only ciliate. Glabrescent forms may show similarities with *C. glabella*, but are easily distinguished by the rotate opened flowers, yellow triangular-ovate petals and brown stamens. Some flowers on a specimen from near Cape Riche (34° 36' S, 118° 47' E), (*W.H. Harvey* 7, March, 1854), have on the calyx tube a dense red pubescence forming a conspicuous rim round the base of the perianth.

Specimens examined

WESTERN AUSTRALIA: *Aplin* D4/68 (PERTH). *Diels & Pritzel* 228 (PERTH). *Drummond* 62 (MEL; 67 (MEL, NY). *George* 6084 (PERTH). *Goodall* 537, 3961, 1877B (PERTH). *Hamilton* s.n. (NSW 135121). *Harvey* 7 (TCD). *Keighery* 1533 (KINGS PARK). *Morrison* 311 (PERTH); 10322 (BM, BRI, NSW); s.n. (BRI 158233, BM). *Mueller* s.n. (MEL 58751, 58754). *Orchard* 1612 (AD, PERTH). *Preiss* s.n. (G). *Pritzel* 186 (BM, G, NSW). *Royce* 8096 (PERTH). *Wilson* 3880 (PERTH).

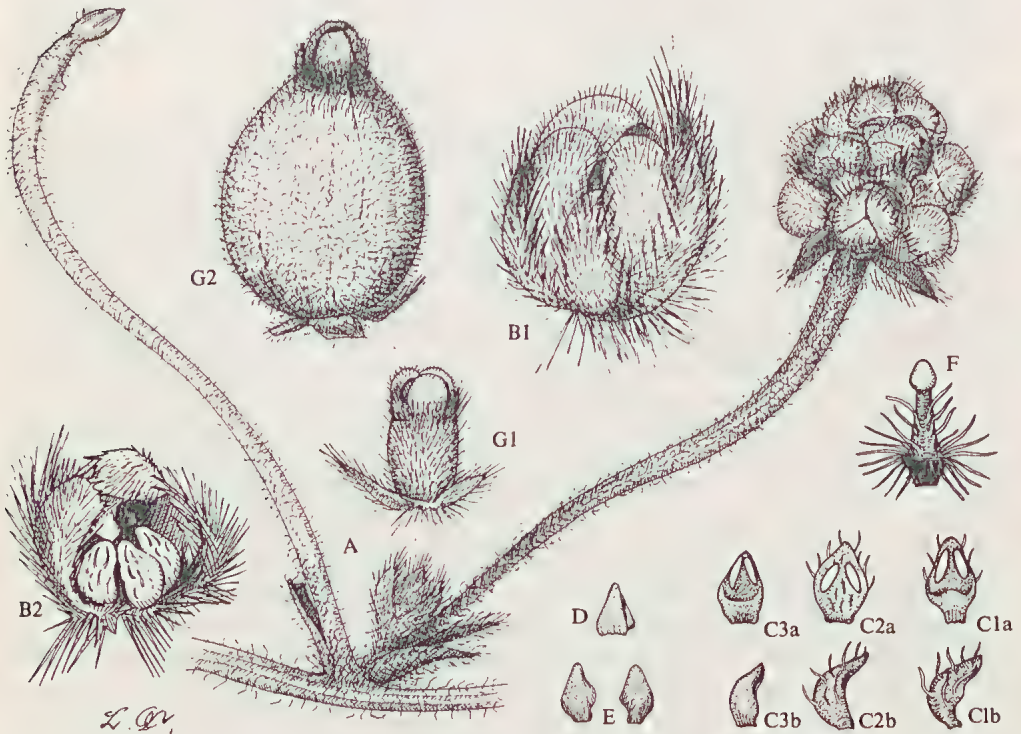


Fig. 11. *Cassytha flava*. A, stem with paired inflorescence, right peduncle with flowers. B, flowers: B1, with bracts; B2, with petals removed to show stamens. C, stamens (a, front view showing loculi; b, side view): C1, second whorl, showing hairs on the back; C2, first whorl, showing filament widened laterally and hairs on the back; C3, third whorl. D, staminode. E, glands. F, ovary and lower style, showing hairs. G, fruit: G1, young fruit with bracts; G2, mature fruit, showing verticillate bracts and perianth with closed orifice.

6. *Cassytha pubescens* R. Br., Prod. Fl. Nov. Holl. 404 (1810); Nees, Syst. Laur. 648 (1836); Meisn. in DC., Prod. 15: 255 (1864); F. Muell., Fragm. Phyt. Aust. 5: 167 (1866); Benth., Fl. Aust. 5: 310 (1870); Schomburgk, Fl. South Australia 55 (1875); Spicer, Handb. Pl. Tasmania 130 (1878); F. Muell., Syst. Census Austral. Pl. 4 (1882); Bailey, Synop. Queensland Fl. 427 (1883); Tate, Trans. R. Soc. S. Aust. 6: 149 (1883); F. Muell., Key Syst. Vict. Plant. 2: 6 (1885); F. Muell., Key Syst. Vict. Pl. 1: 125 (1887-1888); F. Muell., Sec. Syst. Census Austral. Pl. : 7 (1889); Tate, Trans. R. Soc. S. Aust. 12: 62 & 70 (1889); Bailey, Cat. indig. natur. Pl. Queensland 39 (1890); Tate, Handb. Fl. South Australia Extratrop. 205 (1890); Moore, Handb. Fl. New South Wales 19 (1893); Bailey, Queensland Fl. 4: 1314 (1901); Rodway, Tasmanian Fl. 165 (1903); Diels & Pritzel, Bot. Jahrb. Syst. 35: 202 (1905); Dixon, Pl. New South Wales 33 (1906); Bailey, Compr. Cat. Queensland Pl. 423 (1913); Maiden & Betche, Census New South Wales Pl. 82 (1916); Domin, Bibliot. Bot. Band 22, Heft 89(2): 680 (1925); Black, Fl. S. Aust. 1(2): 239 (1922); Hart, Victorian Naturalist 42: 79-83 (1925); Ewart, Pl. Victoria 523 (1931); Black, Fl. S. Aust. 2(2): 365 (1948); Beadle, Evans & Carolin, Handb. Sydney Distr. 133 (1963); Curtis, Stud. Fl. Tasmania 3: 597 (1967); Burbidge & Gray, Fl. A.C.T. 165 (1970); Beadle, Stud. Fl. North Eastern New South Wales 2: 119 (1972); Beadle, Evans & Carolin, Fl. Sydney Reg. 152 (1972); Willis, A Handb. Pl. Victoria 2: 160 (1973).

For fuller bibliography of *C. pubescens* see Kostermans, Bibl. Laur. 234 & 235 (1964).

Type: R. Brown (Bennett 3021), Journey Australia, 1802-5, (most likely New South Wales or Victoria) (BM, lecto., K, iso.). *J. Banks & D. Solander*, Australia, eastern seaboard, 1770, (BM-2 sheets, NSW, syn.). (Lectotypified here.)

C. paniculata R. Br., Prod. Fl. Nov. Holl. 404 (1810); Sprengel, Syst. Veg. 2: 271 (1825); Nees, Syst. Laur. 647 (1836); Meisn. in DC., Prod. 15: 256 (1864); F. Muell., Fragm. Phyt. Aust. 5: 167 (1866); Hooker, Handb. N.Z. Fl. 239 (1867); Benth., Fl. Aust. 5: 311 (1870); F. Muell., Syst. Census Austral. Pl. 4 (1882); Bailey, Synop. Queensland Fl. 427 (1883); F. Muell. Sec. Syst. Census Austral. Pl. 7 (1889); Bailey, Cat. Indig. natur. Pl. Queensland 39 (1890); Moore, Handb. Fl. New South Wales 19 (1893); Bailey, Queensland Fl. 4: 1314 (1901); Cheeseman, Man. New Zealand Fl. 604 (1906); Dixon, Pl. New South Wales 33 (1906); Maiden & Betche, Census New South Wales Pl. 82 (1916); Cheeseman, Man. New Zealand Fl. ed. 2: 461 (1925); Ewart, Handb. Forest Trees Victoria 125 (1925); Hart, Victorian Nat. 42: 79 & 83 (1925); Allan, Fl. New Zealand 1: 137 (1961); Beadle, Evans & Carolin, Handb. Sydney Dist. 133 (1962); Beadle, Stud. Fl. North Eastern New South Wales 2: 119 (1972); Beadle, Evans & Carolin, Fl. Sydney Reg. 152 (1972).

For fuller bibliography on *C. paniculata* see Kostermans, Bibl. Laur. 233 (1964).

Type: R. Brown, Port Jackson, Aug. 1803 (BM, syn.); *J. Banks & D. Solander*, eastern seaboard, 1770 (BM, syn.).

C. paniculata var. *phaeolasia* F. Muell., Frag. Phyt. Aust. 5: 167 (1866), basionym of *C. phaeolasia* (F. Muell.) Benth.

Type: F. Mueller, East boundary of Gipp's Land (MEL 58512, lecto.); *F. Mueller*, near Womboyn(e), Sept. 1860 (MEL 58510, MEL 58511, NSW 134542, syn.). (Lectotypified here.)

C. phaeolasia (F. Muell.) Benth., Fl. Aust. 5: 310 (1870); F. Muell., Syst. Census Austral. Pl. 4 (1882); F. Muell., Key Syst. Vict. Pl. 2: 6 (1885); F. Muell., Key Syst. Vict. Pl. 1: 125 (1887-8); F. Muell., Sec. Syst. Census Austral. Pl. : 7 (1889); Moore, Handb. Fl. New South Wales 19 (1893); Dixon, Pl. New South Wales 33 (1906); Maiden & Betche, Census New South Wales Pl. 82 (1916); Ewart, Handb. Forest Trees Victoria 124 (1925); Hart, Victorian Nat. 42: 79-83 (1925); Ewart, Fl. Victoria 522 (1931); Hart, Victorian Nat. 63: 12-13 (1946); Willis, Handb. Pl. Victoria 2: 160 (1973).

C. pubescens Schldtl., Linnaea 20(5): 577 (1847), nom. illeg.: Benth., Fl. Austral. 5: 310 (1870).

Type: H. Behr 44, Bethany, South Australia (HAL 42844, holo.).

C. piligera Schldtl., Linnaea 21: 446 (1848); Meisn. in DC., Prod. 15: 255 (1864); Benth., Fl. Austral. 5: 310 (1870); Bailey, Queensland Fl. 4: 1314 (1901); Eichler, Suppl. J.M. Black's Fl. South Australia 150 (1965).

Type: H. Behr 44, as for *C. pubescens* Schldtl., (Schlechtendahl, l.c. renamed *C. pubescens* Schldtl., as it was homonymous with R. Brown's *C. pubescens*.)

C. pubescens var. *fasciculata* Meisn. in DC., Prod. 15: 255 (1864), based on type of *C. piligera* Schldtl.

C. pubescens var. *macrostachya* F. Muell., Fragm. 5: 167 (1866) nom. nud.; Hart, Victorian Naturalist 42: 79-81 (1925) (quoad spec. *F. Mueller s.n.*, between Port Fairy and Portland Way (MEL 58562), annotated by Mueller).

C. glabella Herb. Sieber n. 218 (BM, G-2 sheets, HAL 42845, K, P-2 sheets), Meisn. in DC., Prod. 15: 256 (1864), pro syn.

C. remotiflora F. Muell. ex Meisn. in DC., Prod. 15: 256 (1864), basionym for *C. paniculata* var. *remotiflora* (F. Muell. ex Meisn.) Benth.

Type: F. Mueller, Moreton Island, Aug. 1855 (MEL 58504, lecto.; K-2 sheets, NY, iso.).

C. paniculata var. *remotiflora* (F. Muell. ex Meisn.) Benth., Fl. Aust. 5: 311 (1870); Bailey, Queensland Fl. 4: 1314 (1901); Bailey, Compr. Cat. Queensland Pl. 439 (1913).

C. rugulosa Meisn. in DC., Prod. 15: 255 (1864); Benth., Fl. Aust. 5: 310 (1870); Bailey, Queensland Fl. 4: 1314 (1901).

Type: Fraser 77, N. Holland (K, lecto.; NY, iso.).

C. tasmanica Meisn. in DC., Prod. 15: 252 (1864); Benth., Fl. Aust. 5: 310 (1870); Bailey, Queensland Fl. 4: 1314 (1901).

Type: R. C. Gunn 532, George Town, 23.x.1843 (K, lecto.; NY); R. C. Gunn 532, Kangaroo Bottom, 23.ix.1840 (K, syn.); R. C. Gunn 532, V.D. Land—Tasmania (K-? syn.).

C. tepperana Ludw. ex Tepper, Bot. Centralblatt 49(51): 5 (1888); Tate, Trans. R. Soc. S. Aust. 12: 62 (1889); Eichler, Suppl. J. M. Black's Fl. S. Aust. 150 (1965).

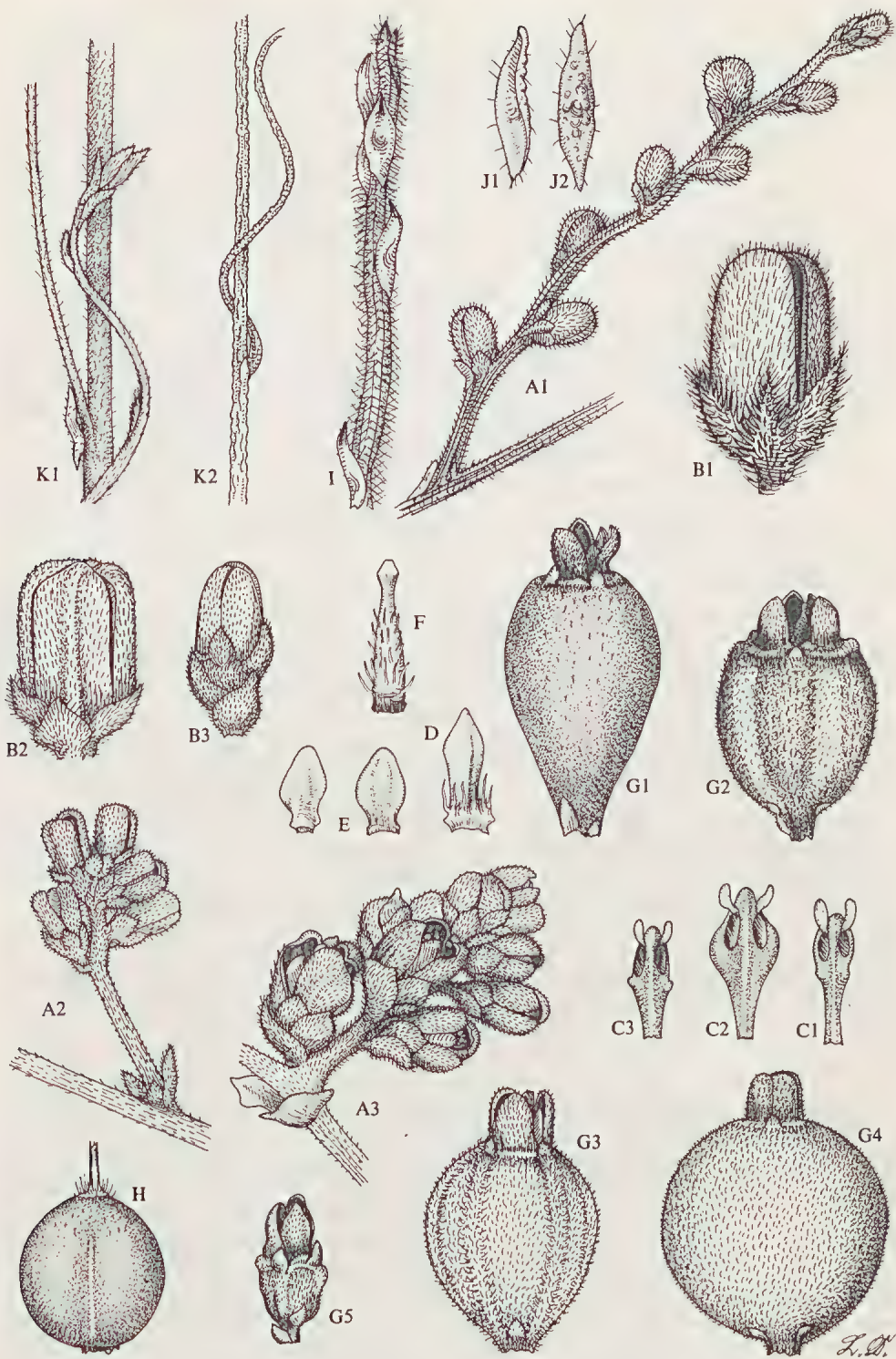
Type: J. G. O. Tepper, Karatta, 11.xi.1886 (MEL 58665, lecto.); Karatta, 14.xi.1885; Karatta, 14.xi.1886; Grassy Creek, 26.ii.1886 (AD 966100718, syn.); Karatta, 10.xi.1886; Karatta, K.I. (AD 97424442, syn.); Kangaroo I. (AD 97424445, MEL 58682, syn.).

Vernacular names

"Dodder-laurel", Ewart (1931); "Spilled Devil's Twine", Ingram (1941); "Blackfellow's Twine", Bourke (1953); "Devil's Twine", Burbidge & Gray (1970); "Downy Dodder-laurel", "Rusty Dodder-laurel", Willis (1972).

Stem (0.3-) 0.5-1.5 (-3) mm thick, smooth to rugulose, pubescent to glabrescent, young shoots white or red retrorsely pubescent to woolly, yellow-green, grey-green to reddish. **Haustoria** ellipsoid, 2-3 x 1-2.5 mm. **Leaves** either ovate-peltate or triangular-basifixed; if ovate sometimes constricted medially, acute or obtuse; if peltate, 1.5-4 x 0.9-2 mm, honey-green, glabrescent to pubescent with or without cilia, woolly, occasionally with a gland centrally; if triangular, c. 1.5 x 1 mm, drying dark brown. **Inflorescences** mostly single, often paired, sometimes fasciculate or paniculate. Panicles to 100 mm long, longer if stem bearing lateral peduncles also terminates in a spike or raceme. Peduncles 3-30 (-130) mm long, slender or thick, 0.5-1.2 mm thick, when long stem-like, 2-15 (or more) flowered, pubescent, hairs less than 0.3 mm long, yellow or white and more or less tinted red, adherent or patent, straight or curly. Supporting bract similar to leaves, reflexed; bracteoles ovate, more or less acute, keeled, c. 1.5 x 1 mm, pubescent to glabrescent, more or less ciliate, often unequal in size. **Flowers** ovate to obovate, 1-2.9 x 1-2 mm, sessile or pedicellate, in an almost sessile or well elevated loose or somewhat congested head, often when elevated one or two flowers below remote or all well-spaced on shorter or long peduncle. Floral bracts verticillate or in two planes, ovate, acute, mostly narrower than wider, 0.7-1.5 x 0.8-1.5 mm, more or less peltate, reflexed, sometimes with central gland or triangular, glabrescent, ciliate, pubescent often on both sides, hairs grey, yellow or red, pedicel very short to 1 mm, thin or thick, often hidden by floral bracts. **Sepals** triangular to triangular-ovate, acute, 0.7-1 x 0.5-0.8 mm, pubescent

Fig. 12. *Cassytha pubescens*. A, inflorescences with flowers: A1, loose spike; A2, elevated head; A3, nearly sessile head. B, flower(s) and bracts from same inflorescences as in A. C, stamens, front view, showing open loculi and upright flaps: C1, second whorl; C2, first whorl, showing laterally enlarged filament; C3, third whorl. D, staminode, showing a portion of the receptacle at the base. E, glands, from front (left) and rear (right) view. F, ovary and lower style showing hairs. G, fruits: G1, pyriform, showing basal bracts and rotate apical leathery perianth; G2, ovate, showing pedicel with basal bract and remote higher bracteoles flanking fruit, glandular ring at base of petals and slightly open orifice; G3, obovate, showing bracteole, slight vertical streaks and leathery perianth; G4, globular, showing bracteoles and leathery perianth with closed orifice; G5, young fruit, ribbed (dried), showing pedicel with basal bract, remote higher bracteole flanking fruit, in upper portion a glandular ring with perianth. H, stone, from globular fruit (G4), showing hairs on lower half of style. I, young shoot with scale leaves. J, scale leaf showing hairs: J1, side view; J2, front view. K, habit drawing: K1, smooth stem with young shoot; K2, verrucose stems.



to glabrous, ciliate, honey-yellow to brown, in fruits black, often sunken in glandular ring. *Petals* obovate to ovate, subacute, 1-2 x 0.9-1.5 mm, pubescent, hairs grey, black, yellow or red, short or long, patent or appressed. Fertile *stamens* white like the staminodes and glands, turning brown; stamens of the first whorl ovate, dorsiventrally flattened, 0.7-2.5 x 0.8-1.5 mm, cells obcordate, tip blunt, wide, incurved, filament under cells laterally expanded into arcuate velum, often pointed, sometimes pubescent dorsally, ciliate; stamens of the second whorl oblanceolate, 0.7-1.5 x 0.4-0.5 mm, cells ovate, more or less bulging, tip blunt, incurved, filament narrower than cells; stamens of the third whorl fusiform, 0.6-1 x 0.3-0.5 mm, commonly the cells the widest part and bulging over the glands; tip blunt, more or less incurved. Staminodes pyramidal, cordate or ovoid, 0.3-0.7 x 0.2-0.3 mm, with or without a more or less conspicuous white apical gland. Glands ovoid, 0.3-0.6 x 0.2-0.3 mm, often dorsi-ventrally flattened and crested with a white gland. *Ovary* fusiform, 0.7-1.6 x 0.3-0.5 mm, glabrous or variously pubescent. Receptacular tube pubescent inside. *Fruit* globose to obovoid, (6-) 7-8 (-9) x (4-) 5-6 (-7) mm (dried; when fresh 1.5-2 mm wider), grey, green-grey to green-red, glabrescent to heavily pubescent, indumentum white and mixed red, often broadly streaked, alternately dull-green and dull-red-brown and 6 raised longitudinal ribs more or less protrude; sometimes topped by a flat glandular ring. Floral bracts verticillate or in two planes; if pedicel distally widened then bracteoles flanking base of receptacular tube immersed or more or less patent; fruit drying grey-black or brown or red-black to black. Stone globose to obovoid, c. 4.5 x 3.5 mm, dark-brown to black. (Fig. 12.)

Distribution (Map 7)

Widespread over south-eastern Australia and probably New Zealand, but not entering arid zone. In Queensland south of Tropic of Capricorn, south-west of Rockhampton, west and south of Roma, along the coast south from Fraser Island to Brisbane; in New South Wales along the coast from Coolangatta to Kiah, westwards near St. George, Tottenham, southwards to Albury; in Victoria along the coast from Cape Howe west to Nelson, inland in Gippsland, westwards passing Benambra, Melbourne, Halls Gap, Kaniva north near Pine Plains Homestead; in South Australia south from Mt Gambier along the coast to the top of Gulf of St Vincent, inland from Bordertown and Pinaroo westwards to Tarlee and Cape Jervis, Kangaroo Island and Adelaide. Scattered isolated localities extend westwards in the south-west tip of Yorke Peninsula, Mabel Range in Southern Eyre Peninsula and most westerly c. 20 km south of Yardea where these collections are clearly distinguishable from nearby *C. peninsularis*.

Flowering

Flowering period appears to be unusually long, through summer from Dec.-April, flower buds are formed as early as Aug.; fruits develop slowly from March-April and are shed mostly in Dec.

Affinities

Considerable problems have been experienced in determining the status of specimens here treated under *C. aurea* and *C. pubescens*. They occupy two quite distinct areas: Western Australia from Wagin to the Northern Territory on the one hand and southern Queensland through New South Wales and Victoria, Tasmania to South Australia on the other. At no point do these ranges approach one another to within less than 2,000 km. In the western and north-western species, three moderately distinct subspecific taxa can be distinguished; in the east and south-east species the range in morphological variation is such that no useful taxonomic subdivisions appear to be justifiable. Separation of the western and eastern populations from one another cannot be achieved on the basis of any single character, particularly because of the great variation in the eastern species. However, because of the biological significance of this geographical disjunction, because

of the practical difficulties which would result in recognizing the three western taxa if the whole complex was to be united in a single species, and because of the facility of identification resulting from the geographical separation, it has been decided to maintain two species. In practice these can best be recognized by the occurrence of *C. aurea* only in WA and NT and *C. pubescens* in only Q, NSW, VIC, TAS and SA. The characters used in combination to separate these species are (as indicated in the key):-

- (1) White apical glands present or absent on staminodes and glands
- (2) Size of the flower
- (3) Floral bracts verticillate or in two planes.
- (4) Presence or absence of glandular ring on the fruit.

Similarities

Similarities with *C. filiformis* show in the stem, inflorescence, flowers and indumentum; in distribution these species overlap in Queensland and New South Wales north of 32° S. latitude, but *C. filiformis* differs in having glabrous petals and fruits which are always globose and drying black.

Similarities with *C. rufa* are discussed under that species.

Morphology

Variation in the inflorescence, flowers, fruits and indumentum is great, probably partly due to the wide geographical distribution and isolation of populations. The different morphological characters are not confined exclusively to one area but occur to different degrees in both remote and neighbouring populations. Specimens from Queensland and the north-east corner of New South Wales have rather long peduncles to 10 cm, remote flowers, floral bracts usually verticillate in flower but in two planes in fruit; fruits rather large, c. 9 x 7 mm, if pyriform they are topped with a glandular rim, or globose and glabrescent or pubescent with quite dense white and red striae, red indumentum over more or less bulging ribs. In the Dividing Ranges in New South Wales and eastern Victoria (Gippsland) the peduncles are mostly single, generally 20-30 mm long, flowers in loose heads, fruits c. 6 x 4 mm, more globose, grey and red pubescent, ribs more or less prominent, glandular rim smaller, floral bracts mostly in two planes (split) in flower and fruit. Coastal specimens mainly have longer peduncles (to c. 50 mm), tend to be more pubescent, generally longer hairs and grey and red flowers mostly loose along peduncle, inflorescences often paired or fasciculate to paniculate, fruits c. 7 x 6 mm, obovate with conspicuous glandular rim, ribs more or less prominent, floral bracts verticillate in flower, in two planes in fruit. In Victoria west of Gippsland and eastern South Australia, the inflorescence is usually single, rarely twin, 5-15 mm long, flowers regularly sessile in a loose to congested head, fruit globose, c. 7 x 5 mm, grey-pubescent, including heavily pubescent specimens in Tasmania, but specimens with distinctly pedicellate flowers and paniculate inflorescence were collected on Mt Lofty (South Australia). Rugulose stems are common to a greater or lesser degree in New South Wales, Victoria and South Australia, particularly on Kangaroo Island, where due to big warts the stem is to c. 3 mm thick; the warts making to $\frac{1}{4}$ of the stem, but smooth stems on the same specimens are not uncommon. Young shoots are all pubescent (except a single collection—*L. Durrington* 1237, Moreton Island, 11.x.1973), the peduncles whether thin or thick, are regularly pubescent as well as the bracts, sepals and petals to a certain degree. The indumentum on similar plants from adjacent localities vary in length and colour, and even on different parts of the same plant (young shoots and inflorescences). (Observed also on New Zealand specimens). The androecium, except in size, irrespective of the locality, is fairly homogeneous except occasionally in pubescence; this including the staminodes and glands. In most specimens the ovary is pubescent to a certain degree, indumentum is not related to geographical or other morphological characters. The fruit

in all stages is pubescent, but in the mature stage the hairs may be very sparse (coastal Queensland specimens). (I have never seen a completely glabrous fruit). Systematic treatments separated *C. paniculata*, *C. phaeolasia*, *C. pubescens*, *C. remotiflora*, *C. rugulosa* and *C. tasmanica* mainly on the indumentum, which has been found to be one of the most variable characters. Brown (1810) 404, distinguished *C. pubescens* from *C. paniculata* on branching of the inflorescence, density of the indumentum and shape of the fruit (angular-furrowed or not). Meisner (1864) 252 and 255, described *C. tasmanica*, with dense indumentum, the "Capitatae" group; *C. remotiflora* and *C. rugulosa* were described in the "Spicatae" along with *C. pubescens* and *C. paniculata*. Bentham (1870) 310-311, realizing similarities in the stem and inflorescence and the variability in pubescence, placed *C. rugulosa* and *C. tasmanica* under-synonymy in *C. pubescens*. In the key on account of the pubescence, he segregated *C. pubescens* from the "Glabrous or nearly so" *C. paniculata* and raised Mueller's variety of *C. paniculata* var. *phaeolasia* to a species. He also reduced *C. remotiflora* as "slightly pubescent" to a variety of "glabrescent" *C. paniculata*. Specimens, including the types, always have an indumentum on the stem, especially when young, and on inflorescence, flowers and fruits. The diversity in the composition of the inflorescence with elongated and multiplied peduncles, fasciculate and paniculate forms is not expressed as a geographical nor morphological pattern, nor are characters of the indumentum. The present author, dealing with ample material, found it impossible to subdivide this complex satisfactorily.

Specimens examined

QUEENSLAND: *Bancroft s.n.* (BRI 176705). *Biddulph s.n.* (MEL 58707). *Blake 15947* (BRI). *Briggs 2170* (NSW). *Chisholm s.n.* (MEL 58699). *Clemens s.n.* (BRI 1777828, NY). *Coveny 2008* (BRI, NSW). *Durrington 1237, 1430, 1492* (BRI). *Everist 7749, 10076* (BRI). *Field Nats Excursion s.n.* (BRI 177837). *Fletcher s.n.* (NSW 135123). *Francis s.n.* (BRI 177506). *Gittins 942* (BRI, NSW). *Harrold 112* (BRI). *Hockins 574* (BRI); *s.n.* (BRI 103216). *Hubbard 4421* (BRI, K). *Longman s.n.* (K). *Mueller s.n.* (K). *Petrie 75* (BRI). *Simmonds s.n.* (BRI 112858). *Taylor s.n.* (BRI 062235). *White 6377* (BRI, NY); *s.n.* (BRI 177492, 177499, 177505, 177509, 177833).

NEW SOUTH WALES: *Adams 1517* (B, CANB, MEL, NSW). *Backhouse s.n.* (K). *Barker 1658* (AD, NSW). *Barnes s.n.* (NSW). *Batt s.n.* (MEL 52340). *Beckler 57, 70* (MEL). *Bediscombe 86* (CANB). *Betche s.n.* (MEL 58508, NSW 135115). *Blakely s.n.* (NSW 135002, 135020, 135128). *Boorman s.n.* (NSW 135022, 135057, 135114). *Bourke s.n.* (NSW 134999). *Burbidge 6274* (B, BRI, CANB). *Burgess s.n.* (SYD). *Caley s.n.* (BM). *Cabbage 1112, 1395* (NSW); *1747, 2001, 3034, 4079* (NSW, SYD). *Camfield 58* (NSW); *s.n.* (BRI 177489, NSW 135021, 135050-1, 135053, 135058, SYD). *Campbell s.n.* (CANB 15585). *Carolin 3720, 3785, 8000* (SYD). *Carrick 3259* (AD, CANB); *3271* (AD, BRI, K). *Chapman s.n.* (SYD). *Cheel s.n.* (NSW 135019, 135048). *Chippendale & Constable s.n.* (AD 97505512, NSW 29287). *Cleland s.n.* (AD 97424439, 97424447). *Collie s.n.* (NSW 135127). *Comb s.n.* (BRI 177516). *Constable 5536, 6898* (NSW). *Cousins 154* (NSW); *s.n.* (NSW 135047). *Coveny 2430, 4670* (NSW); *s.n.* (NSW 127718, 135014, 135015, 135017, 135061). *Craven 604* (CANB, CHR, K, L, MEL, NSW). *Cumpston s.n.* (OXF). *Day s.n.* (CANB 10499). *Dunn s.n.* (NSW 134545). *Duryer 741* (NSW). *Evans s.n.* (SYD). *Fawcett 135, 196* (MEL). *Fletcher s.n.* (NSW 135007, 135126). *Ford s.n.* (NSW 135010, 135054, 135062). *Forest. Comm. s.n.* (NSW 134543). *Foster 1421* (BRI, CANB, NSW). *Fraser & Vickery s.n.* (NSW 106391). *Fraser s.n.* (NSW 135068). *Garland s.n.* (MEL 58727). *Glenfield Veterinary Res. Inst.* (NSW 134544). *Gray & Costin 3553* (CANB). *Gray 5480* (CANB, NSW). *Haegi 1421* (AD, NSW). *Hamilton s.n.* (NSW 134504, 135005, 135006, 135008, 135009, 135052, 135113). *Hartley 158* (CANB). *Hochreutiner 3053* (G). *Holland s.n.* (SYD). *Hopkins s.n.* (NSW 135112). *Ingram 1416, 2478, 3100, 5462, 5703, 5801, 6303, 8387, 6846, 10046* (NSW); *s.n.* (NSW). *Jackson 2182* (AD, BM, K); *2211* (AD, MEL, PERTH); *2214* (AD, LY, NY); *2235* (AD, HAL, P). *Jephcott s.n.* (MEL 58557). *Johnson 229, 256* (NSW); *s.n.* (NSW 135023, 135059). *Johnson & Constable 1400* (AD, NSW) *s.n.* (NSW 30372). *Kinnia s.n.* (NSW 135033). *Lamont 122* (BM). *Lauterer s.n.* (BRI 32957). *Leichhardt s.n.* (NSW 135116). *Lithgow s.n.* (NSW 135011). *Lawson s.n.* (SYD). *Maiden s.n.* (NSW 135001, 135063); *s.n.* (LY, MEL 58553, NSW 135000). *McBarron 4329, 5205, 9496* (NSW). *McDonald s.n.* (NSW 135110). *McGillivray 1140* (NSW). *McKee 6907* (CANB, SYD); *8876* (CANB, NSW). *McKie s.n.* (NSW 135111). *Mills s.n.* (NSW 135025). *M'L. Marsh s.n.* (NSW 135524). *Moore 1572, 2067, 3136* (CANB). *Moricand s.n.* (G). *Morrison 5219, 5439* (K). *Mueller (251)* (MEL 58661); *(331)* (MEL 58503, 58520); *s.n.* (MEL 58541, 58543, 58544); *s.n.* (K, MEL 52334); *s.n.* (K). *Musson 32* (MEL). *Myall Lakes Expedition* (SYD). *Nash 27* (AD, PERTH); *s.n.* (AD 97223050, 97223051, 97223052). *Newman s.n.* (SYD). *Pullen 2304* (CANB, NSW). *Ravenscroft s.n.* (MEL 52335). *Reader 17, 19, 23* (MEL). *Rickard s.n.* (OXF). *Rodway s.n.* (K, NSW 135013); *s.n.* (NSW 134982, 135012, 135055, 135056, 135064, 135065, 135066, 135067, 135117). *Rumsey 155* (NSW). *Salasoo 715, 2672, 2966* (NSW). *Schodde 3456* (AD, CANB, NSW). *Solling 235* (NSW). *Tate s.n.* (AD 97424448). *Taylor s.n.* (SYD). *Thom 32* (MEL). *Thompson s.n.* (NSW). *Tindale s.n.* (NSW 135018). *Voyage du Capitaine Baudin* (K). *Walker s.n.* (OXF). *Webb s.n.* (TCD).

Weber 5236 (AD, CANB, NSW, PERTH). *White* 3564 (NSW). *Vickery* s.n. (NSW 106390). *Wools* s.n. (MEL 59560). *Wright* s.n. (NY).

VICTORIA: *Adamson* s.n. (MEL 58608). *Aston* 750 (MEL); 993 (BRI, MEL); 1282, 1683 (MEL). *Barton* s.n. (MEL 58513-4). *Beaglehole* 4654, 9651, 9844, 9860, 17294, 17682, 17684-6, 21117, 21779, 22061, 35237, 35291, 35384 (BEAUGLEHOLE); 28872, 31021, 32227, 32255, 42939 (AD, BEAUGLEHOLE). *Belcher* 141 (AUCK, MEL). *Belche* s.n. (NSW 135040). *Carrick* 3032 (AD, MEL, NY, W). *Chorney* 504 (AD, BM, P). *Connor* s.n. (MEL 58578). *Davies* 87 (AD); s.n. (MEL 58717). *Day* s.n. (CANB 10500). *Haegi* 644 (AD, G, Z). *Hart* s.n. (MEL 58576). *Hochreutiner* 3031 (G). *Hornsby* s.n. (AD 97826045). *Howitt* 235 (MEL); s.n. (MEL 58631). *Jaegerman* 473 (AD, CANB); 489, 510 (AD). *Jephcott* s.n. (MEL 58644). *Kuntze* 20/130 (NY). *Livingstone & Stirling* s.n. (MEL 58566). *McLennan* s.n. (MEL 58384 & 58569). *Morrison* 5072 (NSW, PERTH); 5074 (AD, BRI, NSW, PERTH); s.n. (AD 96412053, BM, BRI 80425, CANB 50233, PERTH). *Mueller* (238) (NY); s.n. (MEL 58562, 58567, 58568 & 58570). *Nash* s.n. (AD 97216239). *Reader* 3, 12, 27 (MEL); s.n. (G, MEL 58563). *Thom* 15 (MEL). *Sayer* s.n. (MEL 58708). *Smith* M.50 (BRI). *Stear* s.n. (NSW 135037). *Stirling* 15 (MEL). *Sullivan* 1 (MEL). *Symon* 55, 1679 (ADW). *Tilden* 764, 1017 (BM, G). *Tonnies* s.n. (AD 97424291). *Wallace* 18, 54 (MEL). *Walter* 1710 (B); s.n. (NSW 135038, 135039). *Webb* s.n. (G). *Weber* 3719 (AD, BRI, CANB); 5237 (AD, B, G, K, P). *White* s.n. (BRI 177497). *Williamson* 6 (MEL); s.n. (NSW 135041). *Willis* s.n. (MEL 52336). *Wilson* 48 (MEL); 1329 (AD, PERTH). *Wooster* s.n. (MEL 58701). *Anon*, Mt Martin (G).

TASMANIA: *Barker* 917, 937 (AD). *Beadle* s.n. (SYD). *Buften* 22 (MEL). *Chinnock* 2156 (AD, HO). *Cleland* s.n. (AD 96804787). *Curtis* s.n. (HO 7442). *Davies* 1263, 1367 (MEL). *Gould* 20 (CANB, HO). *Grave* s.n. (MEL 58683). *Gunn* 532/1842 (BM, NSW); 532 (HO); s.n. (TCD). *Eichler* 16847 (AD, B). *Hemsley* 6034 (NSW). *Hooker* s.n. (MEL 58525). *Ising* s.n. (AD 96601090). *Lemann* 9388 (BM). *Long* 372, 472 (CANB); 522 (CANB, HO). *Lucas* s.n. (NSW 135031). *Maiden* s.n. (NSW 135032). *Maiden & Cambage* s.n. (NSW 135030). *Milligan* s.n. (HO 7445). *Nelson* s.n. (BM). *Rodway* s.n. (CANB 3784, HO 7449, 7452, NSW 135027-9). *Sharman* s.n. (HO 7443). *Sieber* 218 (BM, G, HAL, K, P, PR). *Spicer* 4 (OXF). *Story* s.n. (MEL 58548, 58550-1, 58733). *Stuart* s.n. (MEL 58545). *Anon*, South Port (MEL 58535). ?*Herb. Hooker* s.n. (TCD). *Anon* 653 (MEL); 1693 (MEL).

SOUTH AUSTRALIA: *Alcock* 3002 (AD); 3065 (AD, K); 4032, 4535, 5524 (AD). *Bates* 284 (AD, BRI); 409 (AD); s.n. (AD 97615024). *Beek* 114 (AD). ?*Behr* 49 (MEL); s.n. (MEL 58524, 58531). *Chinnock* 1, 2, 2452 (AD). *Cleland* s.n. (AD 966090653, NSW 135033). *Copley* 1803 (AD). *Czornij* 686 (AD, NY); 692 (AD, MTJB, UV). *Donner* 972 (AD); 1171 (AD, TCD); 2235 (AD, M); 3819 (AD, NY); 4028 (AD, BM); 4766 (AD, G, NY); 5056 (AD, OXF). *Eardly* s.n. (ADW 5020). *Eichler* 12136, 12156, 12175 (AD); 14357 (AD, NY, PRE); 14509 (AD); 15340 (AD, G); 15522 (AD, K); 16244 (AD, G, H, W); 16263 (AD); 16363 (AD, UC); 17667 (AD, B, MEL, NSW); 18593 (AD, BRI, CHR); 19117 (AD, CANB, NSW, PERTH). *Fieldhouse* 48 (AD). *Haegi* 377, 387, 446, 468, 493, 500, 533, 543 (AD). *Headle* 81 (AD). *Hunt* 220, 535 (AD). *Ising* s.n. (AD 96451068, 966021431, 966021434, 96605334, 96935026, 9709348, W). *E. Jackson* 578 (AD, WRSL); 673 (AD, NT); 2337 (AD, MEL, OSH); 2406 (AD). *G. Jackson* 723, 914, 960, 961, 963, 975, 977, 997, 1005, 1006, 1007, 1009, 1011, 1023 (AD). *Jaegermann* 518 (AD, HO). *Koch* s.n. (NSW 135034, PERTH). *Kraehenbuehl* 1565 (AD, K, L, ULT); 2710 (AAU, AD). *Kuchel* 1165 (AAU, AD, JUNGE); 1179 (AD, M). *Lea* s.n. (BM). *Lothian* 1019, 2893 (AD). *McFarland* s.n. (AD 96739028, 97021002). *Menzel* s.n. (AD 97424441, 97424450). *Mueller* s.n. (MEL 58523, 58526-30, 58533, 58540, 58554, 58555). *Nash* 1 (AD, CANB); 10 (AD, NT). *Orchard* 107 (AD); 1816 (AD, B, HAL). *Perry* s.n. (CANB 19441). *Purdie* 179b (AD). *Reader* s.n. (BM). *Riedel* s.n. (AD 96050335). *Roach* 45 (AD). *Rogers* s.n. (NSW 135035). *Schodde* 1062 (AD, CANB, P). *Sharrad* 356, 616, 634 (AD). *Smith* 934 (AD). *Southcott* s.n. (AD 97317235, 9732143, 97329074, AK, BISH, CHR). *Specht* 32 (AD). *Spooner* 1521, 3049, 3975, 4387, 5416, 5468, 5475 (AD). *Symon* 1272 (ADW); 2937 (ADW, K); 6805 (AD, ADW, CANB, L); 10531 (AD, ADW). *Tepper* 11, 46, 49 (AD); 46 (MEL); s.n. (AD 97424442, 97424445); s.n. (MEL 58682). *Wheeler* 137 (AD, NCU); 165 (AD). *Weber* 1576 (AD, CANB); 2022 (A, AD, B, BM); 2033 (AD, MEL); 3035 (AD); 3036 (AD, BRI, NSW); 3543, 3664 (AD); 4348 (AD, MEL); 4411 (AD, CANB); 5233 (A, AD, B). *Whibley* 426 (AD, NT, PERTH); 1285, 1680 (AD); 2065 (AD, CANB, NSW); 2785 (AD, MEL); 2900 (AD, HO, WU); 3603 (A, AD, UPS); 3902 (AD, W, Z); 4117 (AD, TRN, UC); 4178 (AD, OSH); 5821 (AD, L). *Williams* 2099, 5415, 6458 (AD). *I. Wilson* 770 (AD, G, PR). *P. Wilson* 732 (AD); 942 (AD, PERTH); 949 (AD); 1130 (AD, HO, NT).

AUSTRALIA: *Atkinson* 13 (MEL). *Brown* s.n. (NY). *Caley* s.n. (G). *Leschenault* s.n. (BM). *L'hotsky* s.n. (HAL 42846, OXF). *Meebold* 3225, 3253, 10071, 10075 (M). *Sieber* 218 (BM 23, G, HAL 42845, K, M 311/24); 218, 821 (MEL 58423, 58425, NY 31/152, P, PR). *Ventenat* s.n. (G). *Anon* s.n., Nov. Holl. (PR).

NEW ZEALAND: *Cheeseman* s.n. (NY). *Chinnock* 1373 (AD, AK); 1374 (AD, CANB, CHR). *Kirk* 514 (AD, OXF); s.n. (NY). *Orchard* 3569 (AD, AK). *Powell* s.n. (AK, NSW 134970). *Anon* 102 (G).

7. *Cassytha filiformis* L., Sp. Pl. 35 (1753); R. Br., Prod. Fl. Nov. Holl. 403 (1810); Spreng., Syst. Veg. 271 (1825); Wallich, Pl. Asiat. Rar. 2(8): 69 (1831); Nees, Syst. Laur. 642 (1836); Meisn. in DC., Prod. Syst. Nat. Regni Veg. 15: 255 (1864); Benth., Fl. Aust. 5: 311 (1870); F. Muell., Syst. Census Austral. Pl. 4 (1882); Hook. f., Fl. Brit. India 5: 188 (1885); F. Muell., Fragm. Phyt. Aust. 5: 167 (1866); Trimen, Handbook Fl. Ceylon 3: 455 (1895); F. Muell., Sec. Syst. Census Austral. Pl. 7 (1889); Bailey, Queensland Fl. 4: 1314 (1901); Maiden & Betche, Proc. Linn. Soc. N.S.W. 34(2): 364 (1909); Stapf in Thiselton-Dyer, Fl. Cap. 5: 500 (1912); Stapf in Thiselton-Dyer, Fl. Trop. Africa 6: 188 (1913); Bailey, Compr. Cat. Queensland Pl. 437 (1913); Maiden & Betche, Census N.S.W. Pl. 82 (1916); Ewart & Davies, Fl. Northern Terr. 113 (1917); Ridley, Fl. Malay Peninsula 3: 137 (1924); Domin, Biblioth. Bot. 22(89): 679 (1925); Gardner, Enum. Pl. Aust. Occ. 44 (1931); Allen, J. Arnold Arb. 23: 154 (1942); Kostermans in Humbert, Fl. Madagascar. 81: 85 (1950); Sastri, Ind. Bot. Soc. 31: 240-246 (1952); Hutchinson & Dalziel, Fl. West Trop. Africa ed. 2 1(1): 58 (1954); Sastri, Proc. 44th Ind. Sc. Cong. :III, abstr. 240 (1957); Sastri, Bot. Gaz. 123(3): 197-206 (1962); Kostermans in Backer & Bakhuizen van den Brink, Fl. Java 1: 135 (1963); Sastri, Ann. Bot. n.s. 27: 425-433 (1963); Chakravarty, Bull. de l'I.F.A.N. ser. A 752, t. 31 (1969); Long & Lakela, Fl. Trop. Florida 422 (1971); Ross, Fl. Natal 172 (1972); Chang in Fl. Taiwan 2: 409, t. 354 (1976); Schroeder, Calif. Avocado Soc. Yearb. 62: 126-129 (1978).

Lectotype: Rheede, Hort. Ind. Malab. 7: t. 44 (1688). See Notes.

C. archboldiana Allen, J. Arnold Arb. 23: 155 (1942).

Type: L.J. Brass 11675, Balim River, 1600 m alt., (New Guinea), Dec. 1938 (A, holo., n.v.; BRI 009565, iso.).

C. filiformis var. *pseudopubescens* Domin, Biblioth. Bot. Band 22, Heft 89(2): 680(126) (1925).

Type: K. Domin 4200, Emu Park near Rockhampton (Australia), Dec. 1909 (PR 526768, lecto.; BRI, iso.). K. Domin 4199, coast near Brisbane (Australia), Dec. 1909 (PR 526762, syn.). K. Domin 4208, Dividing Range near Pentland (Australia), March, 1910 (PR 526769, syn.).

C. melantha non R. Br. sensu Ewart & Davies, Fl. Northern Territory 113 (1917) quoad spec.: G.F. Hill 509, Tungiegi Waterhole (Australia), 10.viii.1911 (MEL 58482).

C. novo-guinensis Kanehira & Hatusima, Bot. Mag. Tokyo 57(677): 190 (1943).

Type: R. Kanehira & S. Hatusima 12950, Waren, c. 100 km south of Manokwari (New Guinea) 21.iii.1940 (FU, iso.).

C. timoriensis Gandoger, Bull. Soc. Bot. France 60: 519 (1913).

Type: Zipel, Insula Timor, 1865 (LY, holo.; LY, iso.).

The following non-Australian names have appeared as synonyms of *C. filiformis* L. in the literature, but their types have, for the most part, not been examined by the present writer:

C. americana Nees, Syst. Laur. 644 (1836) (vide Stapf [1912]).

C. aphylla Raeusch, Nom. ed. 3: 116 (1797) (vide Kostermans [1950]).

C. brasiliensis Mart. ex Nees, Syst. Laur. 648 (1836). (vide Kostermans [1950]).

C. dissitiflora Meisn., Kjoeb. Vidensk. Meddel 145 (1870) (vide Kostermans [1950]).

C. filiformis var. *subpubescens* Meisn. in DC., Prod. 15: 255 (1864) (vide Allen [1942]).

C. guineensis Schumacher, in Beskr. Guin. Pl. 199 (299) (1827) (vide Stapf [1913]).

C. senegalensis A. Chev., Fl. West Trop. Africa 1: 46 (1938) (vide Hutchinson [1954]).

C. zeylanica Gaertner, Fruct. 1: 134 (1788) (vide Kostermans [1950]).

Names, other than *Cassytha*, applied are:-

Calodium cochinchinense Lour., Fl. Coch. 247 (1790) (vide Kostermans [1950]).

Volutella aphylla Forsk., Fl. Aeg.-Arab. 84 (1775) (vide Kostermans [1950]).

Vernacular Names

"Love vine" Long & Lakela, Fl. Trop. Florida 422 (1971), also J. Eldridge, Econ. Bot. 29(4): 316 (1957) for Bahamas; "False dodder", C.A. Smith, Common names of South African Pl. 489 (1966).

Typification of Cassytha filiformis L.

No collection was cited by Linnaeus. *Cassytha* collections in the Linnaean Herbarium (London) consist of three sheets numbered 519-1, 2 & 3 (Savage Index). The first and the last sheet are not annotated and the second originated from South Africa (C B S = Caput bonae spei). As Linnaeus cited the habitat only as India, the annotated sheet cannot be a type. No specimen of *Cassytha* was included in the microfiche of the Linnaean Herbarium (Stockholm).

Linnaeus cited five references:-

- (1) Camel, Herb. Luzone Philipp. in Ray, Hist. Pl. 3, App.: 1 (1704). This is based on a collection made in the Philippines, but the specimen has not been located.
- (2) Petiver, Gazoph. 77, t. 49, f. 12 (1702-4). Petiver also refers to Ray (1704) and to Camel (1704) and may not have been based on further collections. The illustration is poor.
- (3) Plukenet, Alm. Bot. 126, t. 172, f. 2 (1692). This refers to Rheede (1688), but the illustration appears to have been drawn from a different source, probably an original specimen. No specimen in the Sloane Herbarium (BM) can definitely be shown to have been the basis for the illustration or description.
- (4) Rheede, Hort. Ind. Malab. 7, 83, t. 44 (1688). This is apparently based only on material collected in the southern Deccan Peninsula. No Rheede specimens are known, but the illustration is good.
- (5) Ray, Hist. Pl. Suppl. 551 (1704).

As the identification of the species referred to by these authors cannot be based on any known collection, the best choice for a lectotype is the most definitely identifiable illustration. Rheede, Hort. Ind. Malab. 7, t. 44 (1688) is, therefore, made here the lectotype. Only one species of *Cassytha* occurs in India and this agrees with Rheede's figure and description except that the Indian collections are known to have 9 fertile anthers, not 6 as described by Rheede. However, elsewhere in its distributional range, this species does occasionally have only 6 fertile stamens. Indian collections examined by the present author are indistinguishable from specimens from Australia and the presence of *C. filiformis* in Australia is therefore confirmed. Brown (1810) first identified this species in Australia and no other name has ever been proposed for this Australian species.

Stem filiform, (0.2-) 0.6-0.8 (-1.5) mm thick, pubescent to glabrescent, bright yellow-green, orange to dark red, drying irregularly striate and more or less verrucose. *Haustoria* mostly elliptic, 1-2 mm long. *Scale leaves* ovate to triangular subulate, keeled, 1-2.5 x c. 1 mm, glabrous or indumentum white or red, commonly ciliate, light to dark-brown, occasionally with a gland on the upper surface. *Inflorescence* of single, seldom paired or paniculate elevated spikes; peduncles (3-) 13-50 (-100) x c. 0.5 mm, thinner than stem, heavily pubescent to glabrescent, (2-) 4-8 (-16) flowered. Subtending bract triangular to subulate, 1-3 x c. 1 mm; bracteoles similar, smaller, pubescent to glabrescent, ciliate. *Flower* sessile, globular-ovoid, 1-2 x 0.8-1.5 mm. Floral bracts verticillate (in plane); bract ovate to triangular, acute, c. 1 x 0.6 mm pubescent to glabrescent, ciliate; bracteoles similar, smaller. Receptacular tube short, glabrous. *Sepals* triangular, 0.6-1 x 0.5-0.9 mm, pubescent to glabrescent, ciliate. *Petals* ovate, bluntly acute, 1-1.8 x 1-1.5 mm, glabrous on both sides, rarely with appressed papillose pubescence inside, white to green. Fertile *stamens* 9, or 6 when three of the third whorl sterile, white, giving white appearance to the flower, drying brown; stamens of the first whorl angular-ovate, c. 1 x 0.4-0.6 mm, anthers obcordate, c. 0.4 mm across, if filaments expanded laterally and pointed, reaching 0.5-0.6 mm across; stamens of the second whorl fusiform, c. 1 x c. 0.4 mm, anthers obcordate, widest, filament tip inflexed slightly; stamens of the third

whorl oblanceolate, c. 0.7- c. 1 mm long, if fertile, anthers obcordate, c. 0.4 mm across, filament tip deflexed slightly, if sterile then subulate and not more than c. 0.3 mm across, slightly shorter than anthers and straight. Staminodes pyramidal, wedge-shaped on top, white, conspicuously stalked, c. 0.5 x 0.3 mm; glands conical or ovoid, c. 0.35 x 0.25 mm, without white apical gland, in drying turning darker. *Ovary* fusiform, less than 2 mm long and c. 0.3 mm across, glabrous or with ring of hairs in central portion. Receptacular tube glabrous or pubescent inside. *Fruit* ovoid to nearly globular 4-8 x 3-5 mm, glabrous, green or orange to red on maturing, sometimes white, drying commonly black, rarely deep-green with brown vertical stripes; persistent petals vertical or rotate, leathery and brown. Stone globular, 3-4 mm across, dark-grey to black. (Fig. 13.)

Distribution (Map 1)

A pantropic species, it occurs in the tropics and subtropics of both the Old and the New World; in Australia it is distributed in northern regions. The eastern Australian range reaches to nearly 32° latitude south due to the warm coastal climate, but in the west to only 23° latitude south because of cooler and dryer weather conditions. The species is distributed well into arid but warmer regions of Northern Territory and Queensland, but not into the cooler mountains.

Flowering

Flowers all the year round.

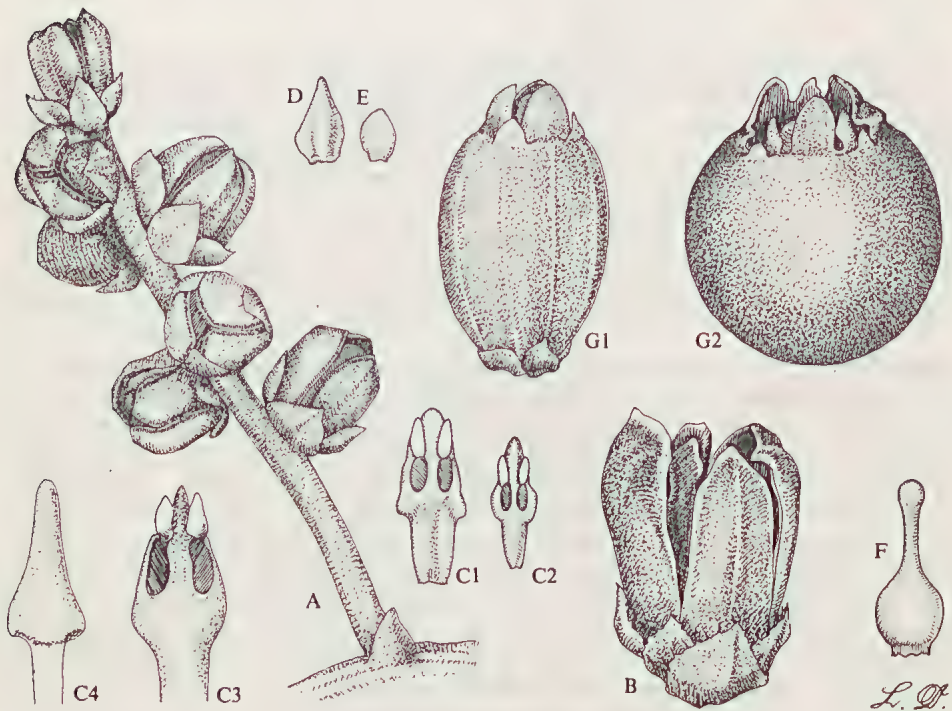


Fig. 13. *Cassytha filiformis*. A, inflorescence in flower. B, flower with bracts. C, stamens, front view showing open loculi and upright flaps: C1, first whorl; C2, second whorl; C3, third whorl; C4, sterile stamen of third whorl. D, staminode. E, gland. F, ovary. G, fruits, showing perianth: G1, ovoid and slightly ribbed lengthwise, showing basal bracts; G2, globose and smooth, showing open orifice.

Notes

Some collections from Northern Australia, having very short peduncles 3-4 mm long and few (3-) flowers, resemble *C. capillaris* (see discussion under *C. capillaris*).

A few unusual forms occur, for example in New South Wales, Indonesia and the Philippines, the plants having a long peduncle (-100mm) bearing numerous remote flowers and the seed maturing basifugally and showing similarities with some specimens of *C. pubescens*, from which they differ in always having glabrous fruit. On some specimens from Queensland the fruits dry dull-green and encrusted with vertical cork-like dark brown lines or stripes. Neither of these forms is sufficiently distinct to justify taxonomic recognition. The appearance as a parasite on many plant species has been observed in many parts of the world such as Mexico, Western Australia, South Africa, New Caledonia, New Hebrides (Schroeder, 1978, p. 128); I have seen it climbing over grasses, bushes and trees.

Identity of *C. archboldiana*

Allen (1942) described *C. archboldiana* from New Guinea on the basis of its 6 fertile stamens, the sterile being in the third whorl. However, collections with the third whorl of stamens sterile have been made in the Kimberley (Western Australia), Arnhem Land (Northern Territory and eastern Queensland), in the Territory of Papua and a single collection in the Philippines (*E. fenix* Bureau of Science No. 26147, vicinity of Tanculan Bukidnom Subprovince, Mindano, July, 1916). The Philippine collection shows a range in reduction of anthers of the third whorl in a single flower, where one stamen has two cells, another one and the third stamen is fully sterile. The specimen from Queensland (E. Jarvis, Cairns, (Australia), Aug. 1913 [BRI 177517]) has all three stamens of the fourth whorl each with a single cell. It is concluded that the fertility or sterility of the inner stamens does not constitute a good taxonomic character and that *C. archboldiana* must be included in synonymy with *C. filiformis*.

Specimens examined

WESTERN AUSTRALIA: *Beaglehole* 11249 (BEAUGLEHOLE, PERTH); 47358 (BEAUGLEHOLE); 46963, 47398, 47526, 48225, 48237, 48327, 51675, 5264, 53071, 53096, 53214, 53748, 53753, 53980 (AD, BEAUGLEHOLE). *Burbidge* 1452 (PERTH). *Fitzgerald* 230, 691, 1453 (PERTH). *Hnatiuk* MP108 (PERTH). *George* 13364, 13380a, 13454 (PERTH). *Kenneally* 3069, 4436, 5118, 6380 (PERTH). *King* s.n. (AD 97509305). *Marchant* 252 (PERTH). *Rust* 146 (PERTH). *Symon* 10126 (AD). *Weber* 4858 (AD, CANB, PERTH). *Wilson* 10869, 11220, 11442, 11515 (PERTH). (? *Oldfield*) (MEL 58350).

NORTHERN TERRITORY: *Adlrick* s.n. (CANB 22199). *Basedow* 9 (AD). *Beaglehole* 46394, 46403, 58186 (BEAUGLEHOLE); 46350, 54668, 54681, 54787, 54893, 59285 (AD, BEAUGLEHOLE). *Byrnes* 1083 (AD, NT). *Chippendale* s.n. (AD, ADW, BRI, CANB, MEL, NSW, NT 987, 4796, 5548, 7008, 8175, 8248). *Hill* 509 (MEL). *Holtze* (313) (MEL). *Latz* 194 (AD, BRI, NT, PERTH); 3304 (CANB, NT). *Letts* s.n. (NSW, NT 8340). *McKean* B110 (BRI, NT). *Mueller* s.n. (MEL 58427). *Must* 929, 946 (CANB, NT). *Ridley* 52 (BRI). *Specht* 166 (AD, BRI); 267, 732, 934, 1047 (AD, BRI, CANB, MEL, NSW, PERTH). *Stocker* 264 (BRI). *Story* 7728 (CANB). *Symon* 7662 (AD, ADW, CANB); 7717 (AD, ADW, CANB, NT); 7719 (AD, ADW); 7724 (ADW); 7734 (AD, ADW); 7771, 7783 (AD, ADW, CANB); 7821 (ADW); 7929 (AD, ADW); 7944 (ADW). *Weber* 1069 (AD, NT, PERTH). *Went* 115 (BRI).

QUEENSLAND: *Bailey* 364 (BRI); s.n. (BRI 176685, 176686, 176693 & 177519, 177840). *Banfield* s.n. (NSW 135087). *Baxter* 758 (BRI). *Beaglehole* 55009 (AD, BEAUGLEHOLE). *Bertland* s.n. (MEL 58702). *Betche* s.n. (NSW 135086). *Bick* s.n. (BRI 177495). *Birck* s.n. (MEL 58745). *Blake* 1495, 22699, 23464 (BRI). *Brass* 291 (BRI, CANB); 2516 (BRI); 18631 (CANB, G); 19903 (CANB). *Clemens* s.n. (BRI 017602). *Coveny* 1999, 2061, 2078 (NSW). *Cubb* s.n. (BRI 073977). *Curtis* s.n. (BRI 062377). *Dietrich* s.n. (MEL 62396). *Done* s.n. (BRI 147285, 147346, 148969, 149090, 149459). *Dovey* 9 (BRI). *Durrington* 216, 360, 388, 598 (BRI). *Eichler* 20720 (AD, BRI, NT); 20752 (AD, CANB, MEL). *Everist* 7241 (BRI). *Fagg* 674 (BRI). *Flecker* 898964 (NSW). *Fosberg* 41311 (NY); 54963, 55002 (BRI). *Gorton* s.n. (BRI 177822 & 177823). *Harrold* 209, 277 (BRI). *Heatwole* s.n. (BRI 146063, 146358, 146401-2, 146426, 147390, 149027, 149375). *Hubbard* 2328, 2681, 2728, 3142 (BRI). *Hyland* 2149 (BRI). *Isbell* s.n. (BRI 113915). *Jaegermann* s.n. (AD 97730137, MEL, NSW). *Jarvis* s.n. (BRI 177517). *Johnson* s.n. (MEL 58613). *Jones* 1496, 3015 (CANB). *Kingston* s.n. (BRI 086384). *Langdon* s.n. (BRI 177821). *Lawrie* s.n. (BRI 140240, 149950). *Leach* s.n. (BRI 176703). *Longman* s.n. (K). *McDonald* s.n. (BRI 176700). *McKee* 9367 (K, NSW); 10262 (CANB). *Morain* 242 (BRI). *Mueller* s.n. (MEL 58353,

58619). *Nash* 21-23 (AD). *O'Shanesys s.n.* (MEL 58351, 58359, NSW). *Perrys s.n.* (BRI 177502). *Persietz* 39, 109, 209, 337, 961 (MEL). *Purcell s.n.* (BRI 056118). *Rodway s.n.* (NSW 135118). *Ross* 6 (MEL). *Sayer s.n.* (MEL 58739). *Sharpe* 1233 (BRI). *Slater* 51 (CANB). *Smith* 11009 (BRI). *Soutte s.n.* (BRI 177512). *Specht* 194 (BRI). *Stephenson* 661 (BM). *Story & Yapp* 300 (CANB). *Tindale s.n.* (AD 97218203). *Thomson* 144 (K). *Tryon s.n.* (BRI 176704, 177514). *Walker ANU370* (BRI, CANB). *Webb* 761, 2414 (CANB). *White* 12410 (BRI); *s.n.* (BRI 176684, 177490, 177507, 177510-1, 177812). *Whitehouse s.n.* (BRI 176702, 177518). *Anon s.n.*, Dalrymple I. (BRI 177498); *s.n.*, Heron I. (CANB, NSW, SYD); *s.n.*, Ipswich (BRI 177513); *s.n.*, Maroochie (BRI 176682-3); *s.n.*, Whelsmian Port (BRI 177496).

NEW SOUTH WALES: *Boorman s.n.* (NSW 135088, 135090). *Carrick* 3272 (AD, BRI, NSW). *Coveny* 4645, 4651, 5029 (BRI, NSW). *Fawcett* A71 (MEL). *Guilfoyle s.n.* (MEL 58633). *Ingram s.n.* (NSW); 5074, 9457 (NSW). *Johnson s.n.* (NSW 42324). *Rothwell s.n.* (NSW 135119).

EX AUSTRALIA (From 210 examined specimens selected)

AUSTRAL ISLANDS: *Quayle* 280 (BRI). BRAZIL: *Pires & Westra* 48870 (NY). BURMA: *Parker* 2766 (MEL). CAROLINE ISLANDS: *Anderson* 2108 (NY). *Fosberg* 46693 (NY). CEYLON: *Alston* 2396 (BRI). CHINA: *Tsang, Wai-Tak* 3 (LY, NY). CHRISTMAS ISLAND: *Fosberg & Metraux* 13213 (CANB). CUBA: *Palmer* (359) (NSW). FIJI: *Smith* 4743 (BRI). HAWAII: *Degener* 24245 (NSW, NY). HONG KONG: *Wilford* 107 (MEL). INDIA: *Thomson s.n.* (MEL 62334). INDONESIA: *De Haan* 1723 (BO, NY); *Lam* 430J (BO, BRI). JAMAICA: *Harris* 39 (NY). JAVA: *Kuntze s.n.* (NY). LOW ARCHIPELAGO: *Chapin* 810 (NY). MALAYA: *Carrick* 2597 (A, AD, NY, SING). MARIANNE ISLANDS: *McGregor* 444 (NSW, NY). MARSHALL ISLANDS: *Fosberg* 33964 (NY). MOSAMBIQUE: *Marques* 100 (NSW). NEW CALEDONIA: *Schlechter* 15643 (NSW); *Guillaumin* 729 (NY). NEW GUINEA: *Brass* 5795, 8639 (BRI, NY); *Pullen* 1180 (CANB); *Ridsdale NGF* 33530 (A, BISH, BOG, CANB, K, L, LAE, SING). NEW HEBRIDES: *Morrison s.n.* (MEL 62354); *Quaife* 261 (NSW). ONOTOA: *Moul* 8056 (NY). PALAU ISLANDS: *Takamatsu* 1583 (BRI). PAPUA: *White* 61 (BRI). PHILIPPINES: *McGregor* 32513 (BRI). PUERTO RICO: *Little* 21670 (NY). SAMOA: *Christophersen* 1933 (NY). SINGAPORE: *Burkil* 459 (BRI, SING). SOLOMON ISLANDS: *Brass* 3069 (BRI, NY). SOUTH AFRICA: *Maguire* 1681 (SAM). SURINAME: *Irwin & al.* 55954 (NY). TAIWAN: *Tanaka & Shimada s.n.* (MEL 62344, NT, TAI 13519). TIMOR: *Steenis* 18110 (CANB, L). TUAMOTU ARCHIPELAGO: *St John* 14364 (BRI, NY). UNITED STATES OF AMERICA: *Bailey* 6020 (MEL).

8. *Cassytha peninsularis* J.Z. Weber, sp. nov.

Caulis 0.5-2.6 mm crassus, glabriusculus. *Folia* ovata vel angulato-ovata, 1.5-4 x 0.4-1 mm, peltata, glabrescentia, ciliata. *Haustoria* elliptica, 1-2 x c. 1 mm. *Inflorescentia* singular vel fasciculata et glomerulata, pedunculus simplex vel breviter, divisus, 1-7 x 0.5-1 mm, 1-5 floribus. *Flores* ovoidei, demum obovoidei, 1.7-2.5 x 1-2.3 mm, pedicellati; floris bracteae in planitibus duobus. *Sepala* triangularia vel ovata, 0.9-1.2 x c. 1 mm, raro pubescentia, ciliata; *petala* ovata vel triangulari-ovata, 1.5-2 x c. 1.5 mm, glabriuscula, flava. *Stamina* fertilia 9; stamina ordinis primi ovata, 1.5-2 x c. 1 mm, filamentis alatis; stamina ordinis secundi oblanceolata, 1-2 x c. 0.5 mm, cellulae latissimae; stamina ordinis tertii obovata, 1-1.8 x c. 0.5 mm, cellulae latissimae. *Staminodia* cordata vel pyramidata, 0.6-1 x c. 0.5 mm, apica albo-glandulata vel eglandulata; glandulae ovatae vel obovatae, 0.4-0.8 x 0.3-0.4 mm, apicibus glandulatis vel eglandulatis. *Gynoeceum* pubescentium vel glabrum. *Fructus* globosi vel obovoidei, 7-9 x 5-6.5 mm, pubescentis rufis at albis striatis vel glabriusculi, apicibus annulatis glandulosis, exsiccatis cano-brunneis vel denigratis.

Type: J.Z. Weber 4462, just south of Port Rickaby (34° 41' S; 137° 29' E); 11.xii.1974 (AD 97506118, holo., CANB, MEL, NSW, PERTH, iso.).

Stem 0.5-2.6 mm thick, glabrescent, rarely rugulose, yellow-green, green to green-red. Young shoots pubescent. *Leaves* fleshy, ovate to angular-ovate, 1.5-4 x 0.4-1 mm, peltate, glabrescent, ciliate. *Haustoria* ellipsoid, 1-2 x c. 1 mm. *Inflorescence* raceme or panicle, few to 20 flowered; peduncles single or fasciculate, 1-7 x 0.5-1 mm, 1-5 flowered, fewer flowered shorter. Supporting bract angular-ovate or triangular-ovate, 1-1.5 x c. 1 mm, deflexed, fleshy or leathery, puberulent, ciliate, sometimes with gland basally; bracteoles similar, smaller, glandless; at each division of peduncle a similar set. *Flowers* ovate to obovate, 1.7-2.5 x 1-2.3 mm; pedicel 0.2-1 x c. 0.4 mm, in flower hidden by floral bracts, not enlarged in fruit; floral bracts in two planes; bract triangular or ovate, c. 1.5 x 1-1.2 mm, pubescent, ciliate; bracteoles triangular to ovate, 0.9-1.1 x 0.8-1 mm, mostly pubescent. *Sepals* triangular to ovate, 1-1.2 x c. 1 mm, sometimes pubescent, ciliate, turning brown, leathery in fruit, quite immersed in glandular rim. *Petals* ovate or triangular-ovate, 1.5-2 x c. 1.5 mm, more or less puberulent outside, pubescent inside, yellow in flower, leathery in fruit; receptacular tube pubescent. Fertile *stamens* 9, white, drying brown;

stamens of the first whorl ovate or narrow-ovate, 1.5-2 x c. 1 mm, filament expanded laterally and widest in central position; stamens of the second whorl oblanceolate; stamens of the third whorl obovate, 1-1.8 x c. 0.5 mm, cells widest. Staminodes fleshy, cordate or pyramidal, 0.6-1 x c. 0.5 mm, white, drying brown, with or without white glandular tip; glands ovate or obovate, 0.4-0.8 x 0.3-0.5 mm, white, drying brown, with or without white apical gland. Ovary fusiform, 1-2 x 0.5-0.7 mm, glabrous or with ring of hairs medially, stigma capitate, white, brown in fruit. Receptacular tube pubescent inside. Fruit obovoid or globular, 7-9 x 5-6.5 mm, pubescent and broadly streaked, alternately dull-green and dull-red or glabrescent and not streaked; topped with glandular rim more conspicuous in dried state. Stone ovate, 4-5.5 x 3.5-4.5 mm. (Figs 14 & 15.)

Distribution (Map 8)

Endemic to South Australia in the Flinders Ranges, Eyre Peninsula, Yorke Peninsula and Kangaroo Island.

Flowering

Flowering from Apr.-March, mature fruits occur throughout the year.

Key to Varieties

1. Staminodes and glands with a white apical gland; ovary with ring of hairs medially; fruit streaked with alternate bands of white and red hairs, drying green and brown ... 8a. var. *peninsularis*
1. Staminodes and glands without apical gland; ovary glabrous; fruit glabrescent, not streaked, drying black 8b. var. *flindersii*

8a. *Cassytha peninsularis* var. *peninsularis*

Stem (0.5-) 0.7-1 (-2.6) mm thick. *Leaves* ovate, subacute, c. 2 x 1 mm, more or less sprinkled with hairs, often with central gland. *Haustoria* ellipsoid, c. 2 x 1 mm. Supporting bract of inflorescence angular-ovate, c. 1.5 x 1 mm, fleshy, light-brown, maturing black, bracteoles ovate, c. 1.2 x 1 mm. Floral bract ovate, cordate, subacute, c. 1.5 x 1.2 mm, light-brown, turning brown; bracteoles triangular-ovate, c. 0.9 x 0.8 mm, pubescent, ciliate, green to light-brown, turning brown. *Flowers* yellow (1.7-) 2.3 (-2.5) x (1.1-) 1.8 (-2.3) mm. *Sepals* triangular, c. 1.2 x 1 mm, pubescent to only sprinkled with a few hairs, ciliate, light brown. *Petals* ovate, c. 2 x 1.5 mm, glabrous or occasionally only sprinkled with a few hairs outside, yellow, in fruit dark brown. Receptacular tube streaked with 6 alternate vertical bands of dense red and white indumentum. *Stamens* of the first whorl narrow-ovate, c. 2 x 1 mm, cells bulging, tip blunt; stamens of the second whorl c. 2 x 1 mm, tip blunt; stamens of the third whorl c. 1.8 x 0.5 mm, cells bulging over staminodes and glands. Staminodes cordate to pyramidal, laterally compressed, c. 1 x 0.7 mm, conspicuously white-glandular crested; gland obovate, c. 0.8 x 0.5 mm, conspicuously white-glandular tipped. Ovary c. 2 x 0.7 mm, with ring of hairs medially. *Fruit* globular, c. 7 x 6.5 mm (dried obovate, c. 7 x 5.5 mm), pubescent, broadly streaked alternately with dull-green and dull red-brown hairs; glandular rim much more conspicuous on dried specimens; drying grey-brown. Stone ovate, c. 5.5 x 4.5 mm, light-brown, drying brown. (Fig. 14.)

Distribution (Map 8)

Endemic to southern South Australia, on Eyre Peninsula from Ceduna and Hiltaba southwards to West Point, on Yorke Peninsula from Moonta southwards and on Kangaroo Island.

Flowering

Flowering from October onwards, fruits start to form from March onwards and are mostly shed in December.

Similarities

The species shows similarities with *C. pubescens* in the short peduncle, yellow coloured petals, white-glandular tipped staminodes and glands, floral bracts in two planes, in the streaked fruit and glandular rim on top. In *C. pubescens* these characters are not all represented on a single specimen, but are scattered throughout different geographical forms. When *C. pubescens* has a short peduncle, the floral bracts are verticillate (in one plane) and the staminodes and glands are not white-glandular tipped;

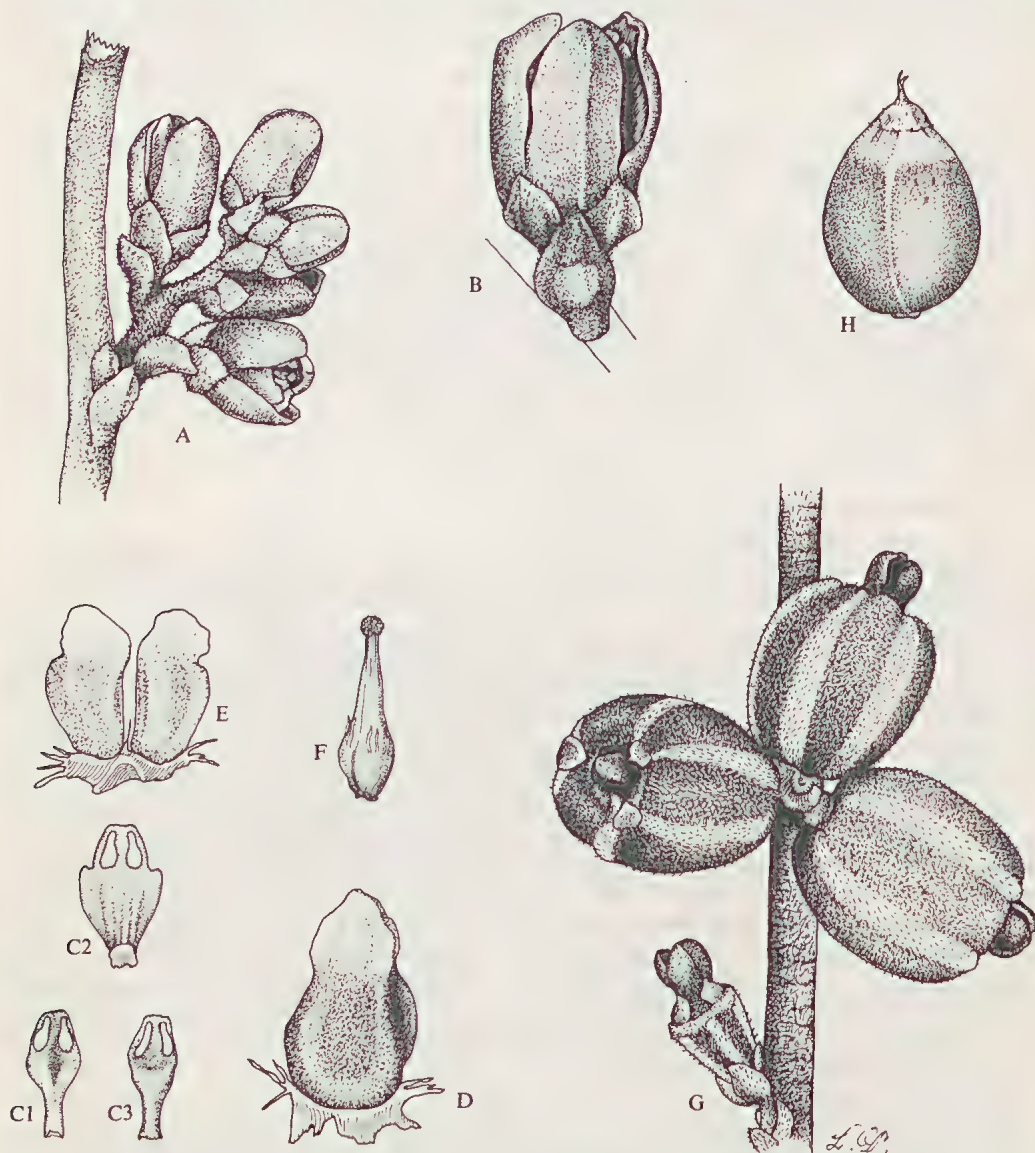


Fig. 14. *Cassytha peninsularis* var. *peninsularis*. A, stem and inflorescence with flowers. B, flower with bract. C, stamens, front view showing loculi: C1, second whorl; C2, first whorl, showing laterally expanded filament; C3, third whorl. D, staminode, side view, showing white apical gland. E, glands, centripetal view, showing white apical gland(s). F, ovary, showing hairs medially. G, fruits, showing short pedicels attached to the peduncle, broadly streaked lines from base to top, glandular apical ring, which is emphasised on young fruit lower and perianth. H, stone.

when the petals are yellow they are heavily pubescent, floral bracts are verticillate and staminodes and glands are not white-glandular tipped; when the fruit is streaked white and red with conspicuous glandular rim on top, the peduncle is over 20 mm long and petals heavily pubescent. These taxa can, therefore, only be distinguished on a combination of characters. This species shows similarities with *C. nodiflora* in the glomerulate inflorescence, yellowish flowers and having staminodes and glands white-glandular tipped, but differs in there being heavily pubescent peduncles in *C. nodiflora*, which has the floral bracts verticillate and glabrous greenish fruit without glandular rim on top nor streaked alternately with white and red stripes. Similarities with var. *flindersii* exist, both having the floral bracts in two planes and glabrescent yellow petals but var. *peninsularis* differs in having pubescent and red and white alternately streaked fruits, white-glandular tipped staminodes and glands, and the ovary being pubescent with a ring of hairs medially.

Note

This is a geographically isolated species, on the eastern side it is separated from populations of *C. pubescens* by the Gulf of St Vincent and on the west from *C. nodiflora* by the Nullarbor Plain. All three species have in common the short peduncles (glomerulate inflorescence) which occurs in some *C. pubescens* specimens in the Mt Lofty Range in South Australia, although other inflorescence types predominate in *C. pubescens* over most of its range.

Specimens examined

SOUTH AUSTRALIA: *Alcock* 1641 (AD, ADW); 2262 (AD); 4562 (AD, PERTH); *s.n.* (AD 96745056). *Andrew* *s.n.* (AD 97424471). *Barker* 1773 (AD, MEL, PERTH). *Bates* 1399 (AD). *Blaylock* 363, 392, 1196 (AD); 1657 (AD, CANB, NSW, HO). *Black, J.M. (Herb.)* *s.n.* (AD 97424470). *Brown* 40 (MEL). *Carter* *s.n.* (ADW 24615). *Chinnock* 1201 (AD, HO). *Copley* 2355 (AD, P). *Eichler* 14162 (AD, LY, P); 15482 (AD, HAL, PERTH); 19161 (AD, AK, BISH, CHR, DELHI); 19287 (AD, G, L); 19324 (A, AD, AK); 19400 (AD, FRIG, GOET); 19419 (AD, CANB, H, L); 19498 (AD, NSW). *Fahlbohm* 89 (MEL). *Haegi* 315, 319 (AD). *Ising* *s.n.* (AD 97701219). *Jackson* 1004 (AD); *s.n.* (AD 97444193). *Kraehenbuehl* 2056 (AD); 3039 (AD, NT, OSH, TRN). *Kuchel* 1313 (AD); 3335 (AD, W). *Lothian* 1140, 3706, 4058 (AD). *Nash* 30 (AD, BRI, MEL, NSW); 31 (A, AD); *s.n.* (AD 97338072, UC, W, Z). *Mueller* *s.n.* (MEL 58532). *Orchard* 2982 (AD, LY, P). *Pearce* *s.n.* (ADW 29663, CANB 209778). *Rohrlach* 53 (AD, G, K). *Smith* 120 (MEL). *Specht* 43, 2024, 2025, 2026, 2393 (AD); *s.n.* (AD 97331292). *Spooner* 2501, 2391 (AD). *Symon* 943 (ADW); 8105B (AD, ADW). *Tepper* 114, 150 (MEL); 598 (AD, MEL); 600, 633, 776 (MEL). *Weber* 3746 (AD, HO, NT); 3748 (AD); 4006 (AD, CANB, MEL); 4076 (AD); 4200 (A, AD, B, Z); 4245, 4300 (AD); 4413 (AD, BM); 4414 (AD). *Wheeler* 594 (AD, SI, W). *Whibley* 5761 (AD, CANB). *Wilhelmi* *s.n.* (MEL 58534). *Wilson* 2672 (AD).

8b. *Cassytha peninsularis* var. *flindersii* J.Z. Weber, var. nov.

Caulis 0.5-1.6 mm crassus. *Folia* angulato-ovata, obtusa, (1.5-) 3-4 x 0.4-1 mm, viridia. *Flores* c. 2 x 1.5 mm, virides primitus, demum flavi; floris bractaea virides primitus, demum bruno-coriaceae. *Stamina* ordinis primi c. 1.5 x c. 1 mm, cruciata; staminodia et glandulae eglandulatae. *Gynoeceum* glabrum. *Fructus* obovoidei, 7-9 x 5-6 mm, glabriusculi, virides vel rufo-flavidi, exsiccati denigrati.

Type: J.Z. Weber 3682, southern slopes of Mt Remarkable (32° 49' S; 138° 10' E), 6.xii.1973 (AD 97338070, holo.; BRI, CANB, G, HO, K, MEL, NSW, NY, OXF, PERTH, iso.).

Stem 0.5-1.6 mm thick, green to green-red. *Leaves* angular-ovate, obtuse, (1.5-) 3-4 x 0.4-1 mm, green. *Haustoria* oval, c. 1 mm long. Bract supporting inflorescence triangular-ovate, 1-1.5 x c. 1 mm, brown, leathery; bracteoles similar, smaller, 0.8-1.3 x c. 0.9 mm. *Flowers* c. 2 x 1.5 mm, first green, later yellow. Floral bract triangular, obtuse, c. 1.5 x 1 mm, fleshy, peltate, green, turning later brown, leathery; bracteoles ovate, 1-1.2 x c. 1 mm, slightly pubescent, ciliate, green, turning leathery. *Sepals* triangular-ovate, c. 1 x 1 mm, green, fleshy, sometimes pubescent with white hairs; *petals* triangular-ovate, subacute-obtuse, c. 1.5 x 1.5 mm, fleshy, first greenish, later yellowish on margins, slightly pubescent outside, densely pubescent inside mostly basally. *Stamens* first greenish, turning white

like the staminodes and glands; stamens of the first whorl cruciform, c. 1.5×1 mm; filament narrowing basally, sometimes pubescent dorsally; stamens of the second whorl c. 1×0.5 mm; stamens of the third whorl c. 1×0.5 mm, filament apically expanded into a small beak. Staminodes obcordate, acute, 0.6×0.5 mm, without white apical gland; glands ovate, c. 0.4×0.3 mm, not white tipped. Ovary c. 1.1×0.5 mm, glabrous. Fruit obovoid, $7-9 \times 5-6$ mm, glabrescent with few scattered white hairs, slightly six-ribbed, pale-green to yellow and red spots, drying black; glandular ring well developed, especially on young fruits and conspicuous on dried specimens, stone c. 4×3.5 mm, black. (Fig. 15.)

Distribution (Map 8)

Endemic to South Australia in the Flinders Ranges from Mt Playford and the Freeling Heights southwards to Mt Remarkable and Mambray Creek. Confined to mountains and usually to higher altitudes.

Flowering

Flowering from April-December, the fruits developing in 6-8 weeks.

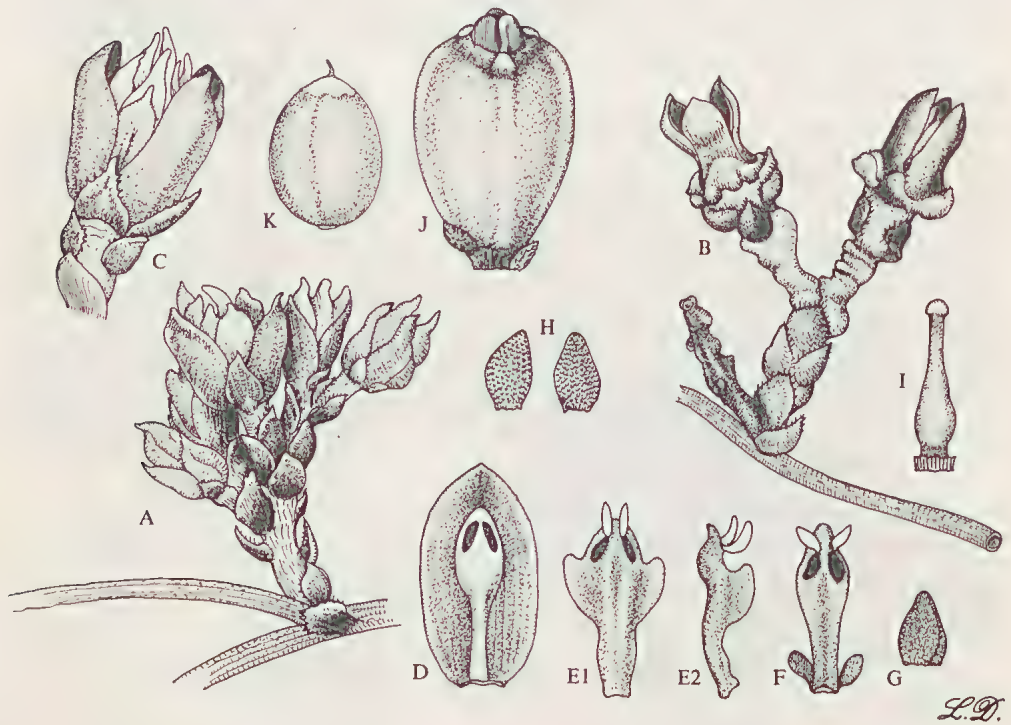


Fig. 15. *Cassytha peninsularis* var. *flindersii*. A, stem and inflorescence with flowers. B, young fruits, with pedicels attached to the peduncle, showing stressed glandular ring at the base of the petals; lower barren peduncle showing scars of fallen fruits. C, flower, showing pedicel with basal bract and remote higher bracteoles subtending flower, stamens protruding between petals. D, petal, from inside, showing dorsi-basally attached stamen from the second whorl. E, stamens of the first whorl, showing laterally expanded filament and upright flap: E1, front view, showing open loculi; E2, side view. F, stamen of the third whorl, showing open loculi and upright flap; two glands are attached basally. G, staminode. H, glands, centripetal view. I, ovary. J, fruit, showing bract at the base of the pedicel and remote higher bracteole flanking fruit; apically faint glandular ring at the base of the perianth which closes the orifice. K, stone.

Similarities

This variety differs from var. *peninsularis* in the young flowers being greenish, staminodes and glands not white-glandular tipped, the glabrous ovary and usually glabrous fruit. The fruit in an early stage is obconical with a prominent glandular rim and almost glabrous; when fully developed it is obovate (sometimes obconical) with only a few sprinkled hairs, drying black. In var. *peninsularis* the fruit in all stages has a spherical base, is pubescent and is clearly marked even from the early stage with 6 red and white vertical stripes. *C. peninsularis* var. *flindersii* resembles *C. nodiflora* in having a glomerulate inflorescence and glabrescent fruit drying black, but differs in having bracts in two planes, staminodes and glands white-tipped, obovate fruits generally larger and with a glandular rim on top while the fruits of *C. nodiflora* are quite sessile, globose and without a glandular rim on top. This variety has similarities with *C. pubescens* from the Mt Lofty Ranges in South Australia in having yellow flowers and short peduncles and the fruit drying black, but differs in not having heavily pubescent petals and fruit nor floral bracts verticillate.

Specimens examined

SOUTH AUSTRALIA: Bates 234, 480 (AD); s.n. (AD 97623143-6, 97623148-9, 97623151, CANB, PERTH). Cooper s.n. (AD 96509235). Donner 4207 (AD); 4911 (AD, BRI); 5026 (AD, MEL, PERTH). Hill 1547 (AD, HO). Hornsby s.n. (AD 97807177, BRI, CANB, M). Kuchel 3085 (AD). Lothian 3150, 5280 (AD). Mueller s.n. (MEL 58485). Weber 3665 (AD, G, K, NY, TCD); 4716 (AD, CANB, FI). Whibley 4245 (AD, P); 4358 (AD, HAL, LY).

9. *Cassytha nodiflora* Meisn. in DC., Prod. 15: 252 (1864); Benth., Fl. Aust. 5: 309 (1870); Muell., Sec. Census Aust. Pl. 7 (1889); Gardner, Enum. Pl. Austral. Occ. 44 (1931); Blackall, How to Know Western Austral. Pl. 1: 168 (1959).

Type: *J. Drummond* Coll. no. 226, "Swan River Colony", (Western Australia), anno 1848 (K, lecto. (nominated here), BM, G, MEL/52333, NSW, NY, TCD, isolecto.; *J. Drummond* Coll. no. 228, "Swan River Colony", (Western Australia), anno 1848 (BM-2 sheets, G, K, MEL/58499, TCD, syn.).

Stem (0.4-) 0.8-0.9 (-1.5) mm thick, glabrescent, yellow-green, green-brown (dried), young shoots white-pubescent with retrorse hairs. *Leaves* ovate, c. 1 x 0.5 mm, acute, pubescent to glabrescent, ciliate, peltate, often with gland centrally and hair tufts basally, drying darker, leathery. *Haustoria* oval, c. 1 mm long. *Inflorescence* a single or fasciculate, spike or short panicle, flowers in crowded glomerules, 3-20 (rarely more) flowered. Peduncles 1-3 x c. 1 mm, grey-pubescent turning brown. Supporting bract ovate, c. 2 x 1 mm, peltate, glabrous, ciliate or with hyaline margin, green turning brown; bracteoles similar or triangular, c. 1 x 0.5 mm, basifixed, at each division of peduncle a similar set of bracts. *Flowers* first ovoid, later obovoid, 1.3-2.7 x 1.4-2 mm, sessile, first greenish, later yellow. Floral bracts verticillate; bract ovate, subacute, c. 1.5 x 1 mm, more or less basifixed, glabrescent, ciliate or with a more or less hyaline margin, yellow-green turning brown, occasionally with central gland; bracteoles similar, c. 1 x 1 mm, basifixed, glandless. *Sepals* ovate, c. 1.2 x 1.2 mm, glabrous (rarely sprinkled with a few hairs), green-yellow maturing yellow, on fruits brown and leathery; *petals* ovate, obtuse, 1.2-2.5 x 1-2 mm, glabrous outside, pubescent inside, yellow when mature, in fruit brown and leathery. Fertile *stamens* 9, firstly white; staminodes and glands turning brown; stamens of the first whorl angular-ovate to cruciform, 1.3-1.9 x 0.6-1 mm, below cells filaments produced laterally into 2 distinct lobes, wider than cells or into a pair of lateral mucros, puberulent on back, ciliate; stamens of the second whorl oblanceolate, c. 1.2 x 0.5 mm, cells wider than filament; stamens of the third whorl angular-obovate, c. 1.3 x 0.4 mm, cells wider than filament, bulging over staminodes and glands. Staminodes pyramidal, c. 0.6 x 0.4 mm, with distinct white glandular tip; glands ovoid, c. 0.5 x 0.3 mm, with distinct white glandular tip. *Ovary* filiform, c. 1.3 x 0.4 mm, glabrous. Receptacular

tube pubescent inside. *Fruit* globular, 5-7 x 4-6 mm, glabrous, green to yellowish-green, sometimes with yellow-reddish stripes, drying black; stone globular, c. 3.5 x 3 mm, black. (Fig. 16.)

Flowering

Flowering specimens have been found from Aug.-Jan., fruits in Sept. and Oct.

Distribution (Map 9)

Endemic to the south-west of Western Australia, from Shark Bay in the south-south-east, east of Geraldton, Morawa, Southern Cross and eastwards to Norseman, preferring sandy flats.

Notes

The two Drummond collections cited by Meisner are conspecific and both agree with the type description. Meisner annotated K and NY specimens and cited, but did not annotate specimens in G. Of these *Drummond* 226 (K) is the most complete and is therefore selected as the lectotype.

Specimens examined

WESTERN AUSTRALIA: *Beauplehole* 1944 (BEAUGLEHOLE); 49383 (AD, BEAUGLEHOLE). *Chinnock* 3101 (AD, W, Z); 3142 (AD, UPS); 3161 (AD, UC, UW); 3331 (AD, TRN); 3771 (AD, OSH). *Donner* 4597 (AD, L, MTJB); 4656 (AD, H). *Haegi* 1120 (AD, G, GOET). *Koch* 3013 (MEL, NSW). *Munir* 5270 (AD, K, NY). *Weber* 5036 (AD, AK, BISH, CHR); 5039 (AD, HAL); 5050 (AD, LY); 5109 (AD, P); 5113 (AD, OXF); 5142 (AD, BM); 5145 (AD, TCD); 5150 (AD, NY); 5202 (AD, HBG); 5206 (AD, M); 5217 (AD, K); 5226 (AD, NSW); 5227 (AD, PERTH). *Whibley* 4592 (AD, PERTH); 4722 (AD, CANB, PERTH). *Young s.n.* (MEL 50500).

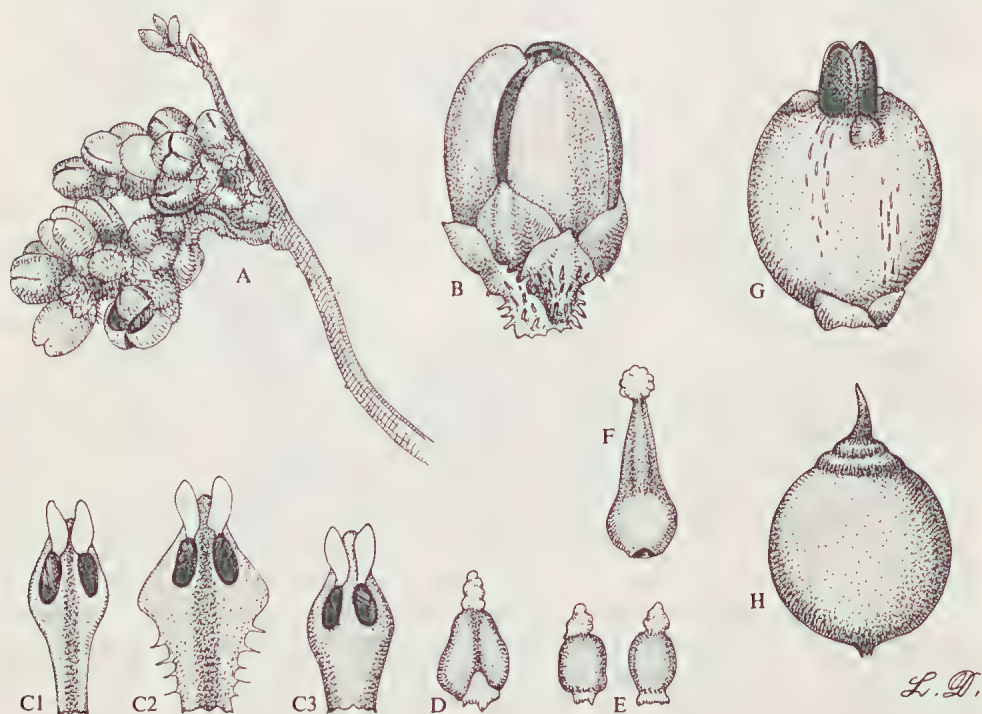


Fig. 16. *Cassytha nodiflora*. A, stem with young shoot and inflorescence with flowers. B, flower with bracts. C, stamens, front view, showing open loculi and upright flaps: C1, second whorl; C2, first whorl, showing laterally expanded filament with cilia; C3, third whorl. D, staminode with white apical gland. E, glands with white apical gland(s). F, ovary. G, fruit, showing bracts and perianth with closed orifice. H, stone.

10. *Cassytha aurea* J.Z. Weber, sp. nov.

Planta tote pubescentia. *Caulis* 0.5-2.2 mm crassus, ramosissimus, cano-viridis, rubro-viridis ad fuscem, pubescens, obsolete striatus (in sicco); *haustoria* elliptica, 1-3 mm longa. *Folia* squamiformia, ovata vel triangularia, 1-2 x 0.5-1 mm, pubescentia, fusca. *Inflorescentia* solitaria, bina, fasciculata vel paniculata; pedunculi 3-30 (raro -110) mm longi, cano- ad flavo-pubescentes, floribus 2-10. Floris bracteae verticillatae; bracteae triangulares, acutae, fuscae. *Flores* ovati, 1-3 x 1-2.2 mm, cano-virides ad aureo-virides, cano-pubescentes; *sepala* triangulario-ovata, 1-1.5 x c. 1 mm, flavo-viridia ad pallido-brunnea, cano-pubescentia; *petala* ovata vel obovata, 0.8-2.5 x 1-1.6 mm, luteo-viridia ad cano-viridia, albo-pubescentia. *Stamina* fertilia 9; stamina ordinis primi angulato-ovata, obtusa, 1-2 x 0.6-1 mm, filo expanso, saepe pubescenti vel ciliati; stamina ordinis secundi lanceolata, obtusa, 1-1.5 x c. 0.5 mm, filamentis saepe ciliolatis; stamina ordinis (3) intima angulato-lanceolata, vel rhombica, 0.8-1.8 x c. 0.6 mm; staminodia obcordata vel pyramidata, apicibus saepe albo-glanduliferis vel apicibus fuscis; glandula angulato-ovata vel ovata, saepe dorso-ventraliter adpressa et apicibus albo-glanduliferis vel fuscis. *Fructus* globosus, 8-10 mm transversus, cano-viridis, cano-lanato-pubescent vel glaber.

Type: J.Z. Weber 4896, c. 25 km west of Giralia Homestead in creek bed along the track to Gales by (22° 39' S; 114° 08' E), 2.x.1975 (AD, holo.; CANB, K, MEL, NSW, NY, PERTH, iso.).

Stem (0.5-) 1 (-2.2) mm thick, pubescent to glabrescent, grey-green, yellow-green to brown. Young shoots woolly pubescent, often reddish. *Leaves* ovate to triangular, more or less acute, 1-2 x 0.5-1 mm, pubescent brown. *Inflorescence* a panicle or of single, paired or fasciculate loose or congested heads or spikes, peduncles 3-30 (-110) x 0.7-2 mm, usually woolly pubescent, hairs curly, yellow or grey. Supporting bract triangular or angular-ovate, more or less acute, 0.5-1.5 x 0.5-1 mm, pubescent, brown; bracteoles triangular, 0.4-3 x 0.4-2.5 mm, pubescent. *Flower* mostly ovate, sessile, 1-3 x 1-2.2 mm, grey-green or yellow-green, heavily pubescent. Floral bracts verticillate; bract triangular, acute, 1-2.5 x 0.8-2 mm, white pubescent outside, glabrous inside, light brown; bracteoles similar, smaller, 0.8-1.5 x 0.8-1 mm. *Sepals* triangular-ovate, 1-1.5 x c. 1 mm, yellow-green to light-brown, pubescent outside, glabrous inside. *Petals* ovate or obovate, subacute, 0.8-2.5 x 1-1.6 mm, white, yellow-green to grey-green, pubescent on both sides with \pm antrorse hairs, in fruit erect or rotate. Fertile *stamens* 9, white or light brown, turning brown; stamens of the first whorl angular-ovate or obovate, widest below cells, 1-2 x 0.7-1 mm, tip obtuse, filament laterally expanded, basally narrowed, mostly pubescent or ciliate; stamens of the second whorl oblanceolate, widest at the level of the cells, 1-1.5 x c. 0.5 mm, cells obcordate, tip obtuse, filament narrow, mostly pubescent or ciliate; stamens of the third whorl narrow-rhomboid, widest at or below the cells, 0.8-1.8 x 0.5-6 mm, cells narrow-obcordate, bulging over staminodes and glands. Staminodes obcordate or narrow-pyramidal, 0.7-1 x 0.4-0.5 mm, shortly stalked, light brown and with white apical glands, or white and without glands but sometimes dark tipped; basal glands angular-ovate, 0.4-1 x 0.4-0.5 mm, either brown, squarish with white apices, when white ovoid and sometimes with darker pointed tips. *Ovary* fusiform, 2-2.5 x c. 0.7 mm, mostly pubescent. Receptacular tube pubescent or glabrous inside. *Fruit* globular, 8-10 mm across, grey-green or yellow-green, heavily pubescent, sometimes long hairs in white and brown stripes, drying grey-black or brown. *Stone* globular, brown, 4-6 mm across. (Figs 17-19.)

Distribution (Map 10)

Endemic to Western Australia and Northern Territory, mostly-coastal.

Flowering

Flowers apparently all year round.

Notes

On some specimens the glandular rim on the top of the fruit is well developed, but in the mature fruit it is overgrown by hairs and less conspicuous.

Key to Varieties

1. Ovary glabrous; fruit glabrous; stamens of the first whorl narrow-rhomboid, $\frac{1}{2}$ as wide as long (northern var.) 10b. var. *candida*
 Ovary pubescent; fruit pubescent; stamens of the first whorl ovate, $\frac{2}{3}$ as wide as long (south-western vars) 2
2. Flowers in loose head; staminodes and glands white tipped 10a. var. *aurea*
 Flowers in congested head; staminodes and glands not white tipped 10c. var. *hirta*

10a. *Cassytha aurea* var. *aurea*

Vernacular Name

"Tangle foot".

Stem (0.7-) 1 (-2.2) mm thick, reddish-green to brown, young shoots mostly woolly-white pubescent. *Leaves* ovate, c. 2 x c. 1 mm, above with dense indumentum of curly hairs, below bristles in tufts. *Inflorescence* various; peduncles 3-30 (rarely -80) mm long, supporting bract triangular, c. 1 x 1 mm; bracteoles similar, smaller. *Flowers* 2.5-3 x 1.5-2.2 mm in loose head, one or two remote below. Floral bract c. 1 x 0.8 mm; bracteoles similar, c. 0.8 mm long. *Sepals* c. 1 x c. 1 mm, grey-pubescent; *petals* ovate, c. 2.5 x 1.6 mm, hairs mostly straight, grey and tinted red. *Stamens* light-brown; stamens of the first whorl rhomboidal-ovate, c. 2 x c. 1 mm, ciliate mostly in lower half; stamens of the second whorl c. 1.5 x 0.5 mm, ciliate in lower half; stamens of the third whorl angular-lanceolate, c. 1.8 x c. 0.6 mm. *Staminodes* obcordate, c. 0.8 x 0.5 mm, light-brown,

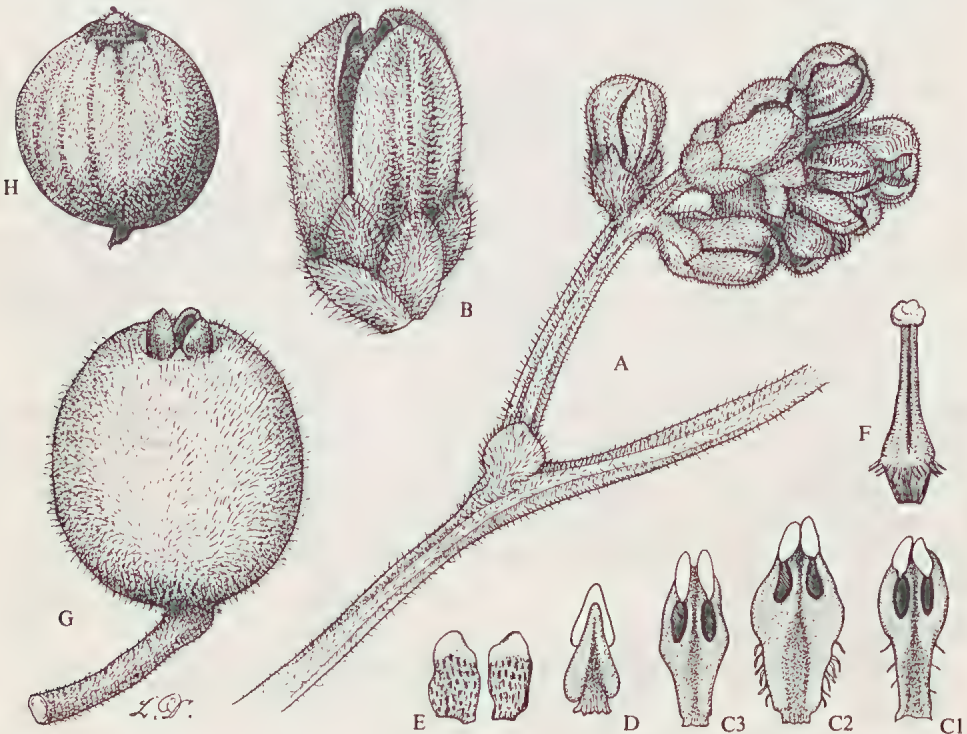


Fig. 17. *Cassytha aurea* var. *aurea*. A, stem and inflorescence with flowers. B, flower with two bracts showing pubescence. C, stamens, front view showing open loculi with upright flaps: C1, second whorl showing with cilia on filament; C2, first whorl, showing laterally widened filament with cilia; C3, third whorl. D, staminode, centripetal view showing white apical gland. E, glands, centripetal view showing white apical gland(s). F, ovary showing median hairs. G, fruit on peduncle showing perianth and indumentum. H, stone.

glandular white tipped; glands angular-ovate, c. 0.7 x 0.5 mm, light-brown, with white apex. *Ovary* with ring of hairs medially. Receptacular tube pubescent inside. *Fruit* grey-green, pubescent, with glandular ring on top (not conspicuous). (Fig. 17.)

Distribution (Map 10)

Endemic to Western Australia in coastal regions from North West Cape southwards to Geraldton.

Flowering

Flowering specimens were collected from August to November, fruiting specimens from June to December.

Similarities

This variety shows similarities with *C. melantha* in the robust stem and loose inflorescence, but differs mainly in having yellow flowers with white indumentum which is antrorse on the petals, pubescent ovary and heavily pubescent fruit.

It differs from var. *candida* and var. *hirta* in having staminodes and glands white tipped.

Specimens examined

WESTERN AUSTRALIA: *Barker* 2141 (AD, AK, BISH, CHR); 2239 (AD, DELHI). *Beaglehole* 12048 (BEAUGLEHOLE). *Carriage* 110 (CANB). *Chadwick* 1389 (PERTH). *Chinnock* 3167 (AD, FRI, G); 3188 (AD, GOET, H); 3809 (AD, MTJB). *Drummond* 10 (MEL). *Jackson* 3149 (AD, OSH, TRN). *Mueller* s.n. (MEL 58688). *MacFarland* s.n. (AD 97722485, M, P). *George* 1286, 6558 (PERTH). *Gribble* 27 (MEL). *Oldfield* s.n. (MEL 58556, 58750). *Reader* s.n. (MEL 58571). *Royce* s.n. (PERTH). *Weber* 4898 (AD, CANB, M); 4908 (AD, NT); 4909 (AD, BRI); 4931 (AD, HO); 4932 (AD, HBG); 4935 (AD, TCD); 4990 (AD, BM); 5011 (AD, G); 5113 (AD, OXF); 5016 (AD, LY); 5023 (AD, HAL); 5035 (AD, PERTH); 5038 (AD, LJU).

10b. *Cassytha aurea* var. *candida* J.Z. Weber, var. nov.

Caules 0.5-1.8 mm crassi, albo-pubescentes; *folia* triangularia, pubescentia. *Pedunculi* 10-110 mm longi, albo-pubescentes, floribus 10-15 vel plus. *Flores* in capitulis elongatis congestis; floris bracteae in planitie una; *sepala* triangularia, albo-pubescentia; *petala* ovata, subacuta, dense albo-pubescentia, antrorsa. *Stamina* oridinis primi angustiora, angulato-lanceolata, 0.7-0.8 mm lata. *Fructus* subglobosus, c. 8 mm latus, fusco-viridis.

Type: A.C. *Beaglehole* 52710, Meda-Oobagooma Road, c. 65 km N. of Gibb River Road, (16° 53' S; 123° 58' E), 12.vi.1976 (AD, holo; Herb. BEAUGLEHOLE 2 sheets, iso.).

Stem (0.5-) 0.7 (-1.8) mm thick, white-pubescent, rarely glabrescent, yellow-green, rarely grey-green or brown-green (dried). *Haustoria* to 1 mm long. Young shoots heavily white-pubescent, *leaves* triangular, acute, c. 1 x 0.5 mm, white-pubescent, green to brown. *Inflorescence* single, appearing indefinite, densely white-pubescent, peduncles (10-) 20-30 (-110) x 0.7-0.9 mm (dried), 10-15 or more flowered. Subtending bract triangular, acute, 0.5-1.5 x 0.5-1 mm, pubescent, brown, bracteoles similar, smaller. *Flowers* globular, ovate to obovate, 1-2.1 x 1-1.6 mm (dried) dull white-pubescent, crowded in the elongated head. Floral bracts in one plane; bract c. 1.2 x 1 mm, pubescent, ciliate; bracteoles similar. Receptacular tube glabrous. *Sepals* triangular, c. 1 x 1 mm, yellow-brown. *Petals* ovate, 0.8-2 x c. 1 mm, densely pubescent with rigid dull white antrorse hairs, less pubescent inside. *Stamens* glabrous, white; stamens of the first whorl angular-lanceolate, usually twice as long as wide, 1-1.8 x 0.7-0.8 mm, cells nearly parallel, expanded filament pointed; stamens of the second whorl lanceolate, 1-1.5 x 0.5 mm, filaments apically enlarged; stamens of the third whorl lanceolate, acute, 0.8-1 x 0.5-0.6 mm, cells obcordate, widest; staminodes narrow pyramidal, acute, c. 0.7 x 0.4 mm, white, turning brown; glands ovate, trilobed, obtuse, c. 0.4 x 0.4 mm, white, turning brown. *Ovary* obpyriform with slender style, glabrous; receptacular tube pubescent inside. *Fruit* glabrescent, sprinkled with few hairs, c. 8 x 8 mm, green with vertical

blotches, drying brown, corky; turning black if dried before ripening. Stone globular, c. 4.5 x 4 mm, brown. (Fig. 18.)

Distribution (Map 10)

Mainly a coastal plant, found in the tropics of Western Australia in the Kimberleys and in Northern Territory in Arnhem Land.

Flowering

Flowering and fruiting simultaneously, probably all year round.

Similarities

This variety shows similarity with *C. rufa*, less with *C. melantha* in the long peduncle to ~110 mm, which continues growth while flowering and fruiting. It differs from them in having flowers at first in a condensed elongated head, later in having brown corky (smooth in unripe) fruits. The narrow stamens of the second whorl are quite similar to those of *C. melantha*, but in *C. rufa* they are wider. It differs from var. *aurea* and var. *hirta* in the glabrous stamens and ovary, and in the glabrescent fruit which is sprinkled with hairs as in *C. melantha*.

Specimens examined

WESTERN AUSTRALIA: Basedow 123 (NSW). Wilson 11290, 11527 (PERTH).

NORTHERN TERRITORY: Martensz & Schodde AE702 (BRI, CANB, DNA, NT). Parker 117 (BRI).

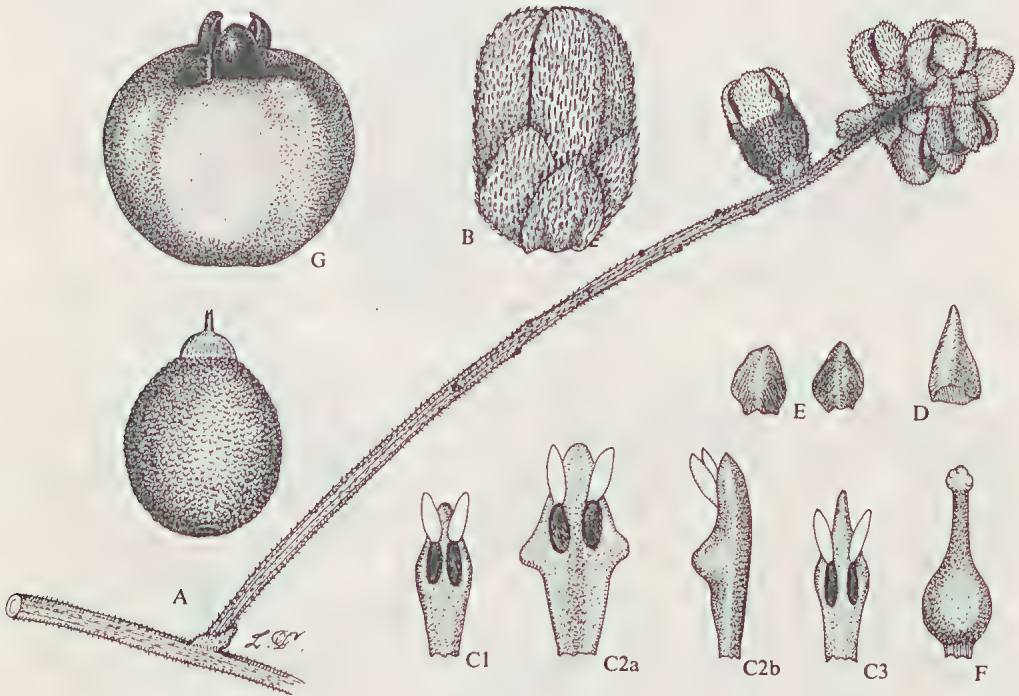


Fig. 18. *Cassytha aurea* var. *candida*. A, stem and inflorescence showing flowers and young fruit. B, flower with bract showing hairs. C, stamens, showing open loculi and upright flaps: C1, front view of second whorl; C2, first whorl, showing laterally expanded filament (a, front view; b, side view); C3, front view of third whorl. D, staminode. E, glands. F, ovary. G, fruit, showing perianth with open orifice.

10c. *Cassytha aurea* var. *hirta* J.Z. Weber, var. nov.

A var. *aurea* differt inflorescentia densa in capitulo hirta staminidiis et glandulis apicaliter fusco-acutiusculis.

Type: J.Z. Weber 5106, c. 31 km east of Geraldton along the road to Mullewa, 15.x.1975 (AD, holo.; CANB, NSW, PERTH, iso.).

Stem (0.6) 1 (-2) mm thick, yellow-green to grey-green, woolly-pubescent to glabrescent, hairs white and tinted black; young shoots often reddish; scaly *leaves* triangular, c. 1.5 x 1 mm. *Inflorescences* commonly paired, sometimes fasciculate and paniculate, in young stage often reddish, later grey and quite persistent after the fruit is shed. *Peduncles* 5-10 mm long, bearing flowers distally condensed in a hairy head. Supporting bract angular-ovate, peltate, c. 1.5 x c. 1 mm, brown, leathery; bracteoles ovate, 1-3 x 1-2.5 mm brown, leathery, one or two carried higher on the peduncle remote from bract. *Flowers* 2-2.5 x 1.5-2 mm, yellowish. *Floral bract* c. 2.5 x 2 mm, pubescent with long white and mixed black hairs; bracteoles triangular to lanceolate, c. 1.5 x 0.8-1 mm, indumentum white and grey. *Sepals* ovate, acute, c. 1.5 x c. 1 mm, apical hairs tinted black; *petals* obovate, yellowish, 2-2.5 x 1.5-1.7 mm, white-pubescent. *Stamens* staminodes, glands and ovary white; stamens of the first whorl angular-ovate, c. 2 x 0.9 mm, pubescent on the back; stamens of the second whorl fusiform, c. 1.9 x 0.6 mm; stamens of the third whorl angular-fusiform, c. 1.8 x 0.7 mm, cells widest, bulging.

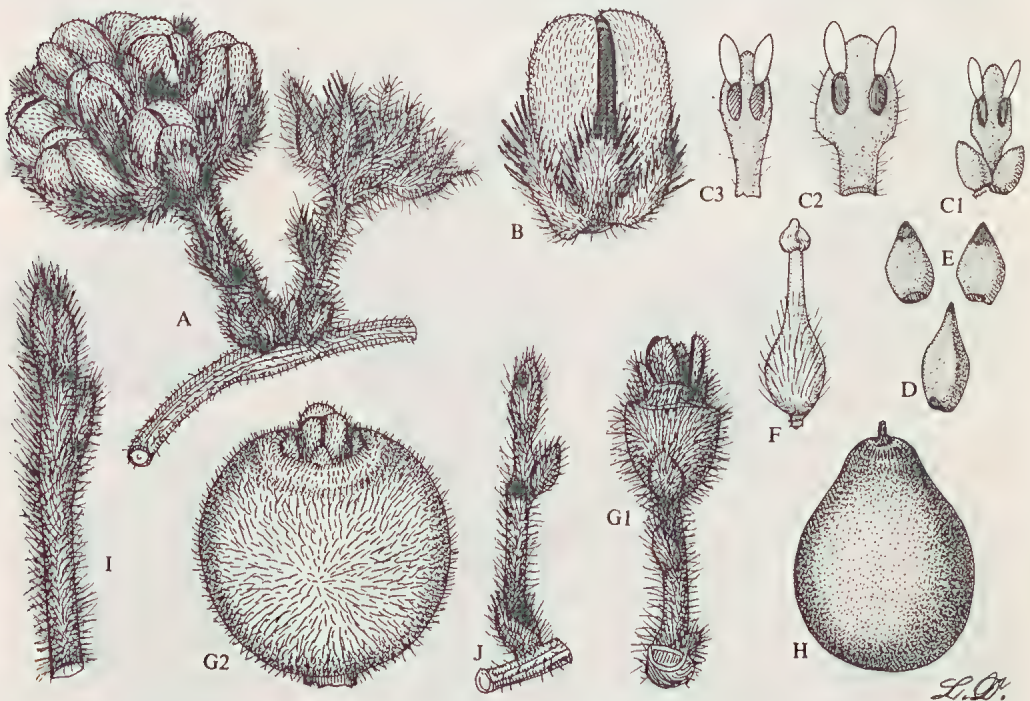


Fig. 19. *Cassytha aurea* var. *hirta*. A, stem with paired inflorescences, immature on right, in flower on left. B, flower with two bracts showing hairs. C, stamens, front view showing open loculi and upright flaps: C1, second whorl, showing hairs on the filament; C2, first whorl, showing laterally expanded filament with hairs; C3, third whorl with basal glands. D, staminode with dark pointed tip. E, glands with dark pointed tip(s). F, ovary and lower style, showing hairs. G, fruits, showing pubescence: G1, young fruit on the peduncle supported by bract, showing terminal glandular ring and perianth; G2, mature fruit, showing faint glandular ring around perianth. H, stone. I, young shoot, showing scale leaves attached basally. J, pubescent peduncle, showing scars of fallen fruits.

Staminodes triangular, pointed, c. 1 x 0.4 mm with slightly dark tip which turns darker; glands ovate, c. 0.7 x 0.4 mm, slightly pointed, with darker tip. *Ovary* slightly angular, pubescent in upper half. Receptacular tube pubescent inside. Ripe *fruit* yellow-green. (Fig. 19.)

Distribution (Map 10)

Endemic to south-western Western Australia from Geraldton southwards to Perth, Tammin and Lake Wagin, which is the furthest point from the coastline.

Flowering

Flowering specimens were collected between August-November, with fruits all the year round.

Notes

It appears that var. *hirta* is a southern extension of *C. aurea* changing around Geraldton from var. *aurea* to var. *hirta*, where both variants were collected, but the intergradation was not observed.

Similarities

This variety shows similarities with var. *aurea* in stamens and fruit, with var. *candida* in the staminodes and glands not being white-tipped but with the tip being darker pointed, from both varieties in having the supporting bracteoles on the peduncle higher, remote from the bract which is at the base, and having flowers in quite condensed, grey-pubescent heads.

Specimens examined

WESTERN AUSTRALIA: Blackall 4526 (PERTH). Burbidge 2039 (CANB). Cronin s.n. (MEL 62372). Eaton s.n. (MEL 58716). Fitzgerald s.n. (NSW 135036). Gardner 8568 (PERTH). Kennelly 1283 (PERTH). McFarland 1296 (AD, M, P). Meebold 6622, 10070 (M). Wilson 6662 (PERTH).

11. *Cassytha rufa* J.Z. Weber, sp. nov.

Caulis 0.5-1.5 mm crassus, pubescens vel glabriusculus. *Folia* triangularia, pubescentia. *Pedunculi* 15-30 (-220) mm longi, rufi, floribus 7-8 vel plus. *Flores* primitus in capitulo laxo, demum remote multiflori et acropetaliter maturescentes; floris bractea verticillatae. *Flores* ovoidei, 1.7-2.3 x 1.2-1.7 mm, pubescentes; *sepala* triangularia, c. 0.8 x 0.7 mm, pubescentia; *petala* ovata, subacuta, 1.5-2.1 x 1.3-1.5 mm, pubescentia rufa vel alba antrorsa. *Stamina* fertilia 9; *stamina* ordinis primi cruciata, c. 1.6 mm lata; *stamina* ordinis secundi c. 0.4 mm lata, filamentis saepe acutiusculis; *stamina* ordinis tertii oblanceolata, c. 0.4 mm lata. *Fructus* globosus, c. 7 x 5.5 mm (in sicco), papillosus, bruneus.

Type: C.H. Gittins 1015, Kennedy Road, c. 3 km N of Pascoe River (12° 45' S; 143° 05' E), Aug. 1965 (BRI 085582, holo.; NSW, iso.).

Stem (0.4-) 0.7-0.8 (-1.5) mm thick, pubescent to glabrescent, indumentum white or red or green-grey to brown (dried). Young shoots densely tomentose with retrorse hairs. *Haustoria* elliptical, c. 1 mm long. *Leaves* triangular, basifixed, c. 1.3 x 0.5 mm, pubescent to glabrescent, ciliate, honey-brown, turning brown to black. *Inflorescences* indefinite, single or rarely paired or fasciculate, peduncles (12-) 20-30 (-220) x 0.7 (-1) mm, usually rusty coloured, red and white pubescent to puberulent, (2-) 7-8 (-16 or many) flowered. *Flowers* at first in a loose head, later remote along the lengthening peduncle and the fruits ripening acropetally, often with fruits basally and few congested flowers in buds terminating. Bract supporting peduncle triangular, acute, c. 1.5 x 1 mm, more or less pubescent and ciliate; bracteoles similar, smaller, c. 1 mm long, sometimes one carried apart higher up on the peduncle. Flowers ovoid, 1.7-2.3 x 1.2-1.7 mm, pubescent yellowish. Floral bracts verticillate; bract triangular, acute, c. 1 x 0.7 mm, red-pubescent, ciliate; bracteoles similar, smaller, c. 0.8 mm long. Receptacular tube short, red or white pubescent. *Sepals* triangular, subacute, c. 0.8 x 0.7 mm, red pubescent, ciliate. *Petals* ovate, subacute, 1.5-2.1 x 1.3-1.5 mm, pubescent on both sides; hairs short, appressed,

antrorse, red and white, margins with darker glabrous rim (dried). Fertile *stamens* 9; stamens of the first whorl ovate, c. 1.2 x 1.6 mm, filament widely expanded, wider than cells, laterally pointed, base narrower; stamens of the second whorl oblanceolate, c. 0.8 x 0.4 mm, filament narrower than cells; stamens of the third whorl oblanceolate, c. 1.2 x 0.4 mm, cells obcordate, wider than filament. *Staminodes* obcordate, c. 0.6 x 0.5 mm, glands ovate, c. 0.4 x 0.3 mm. *Ovary* glabrous. Receptacular tube pubescent inside. *Fruit* globular, c. 7 x 5.5 mm (dried), puberulent, papillose, drying brown, rarely black. *Stone* globular, c. 4.5 x 4 mm. (Fig. 20.)

Distribution (Map 11)

Endemic in Queensland, in Cape York Peninsula from Iron Range southwards, Mt Mulligan, westwards Prairie and south to Cunnamulla.

Flowering

Flowers probably all year round.

Notes

Specimens in flower have shorter peduncles than those in fruit in which peduncles apparently continue to grow in length, (~220 mm; *Brass 19103*), showing scars of fallen fruits and bearing fruits, flowers and flowerbuds terminally, the thick peduncle resembling the stem.

Similarities

This species shows similarities with *C. melantha* and *C. pubescens* in the prolonged inflorescence with remote flowers and fruits, but *C. melantha* has stouter stems and larger flowers, with black retrorse hairs on the petals; from *C. pubescens* it differs in always having sessile flowers and papillose brownish fruits.

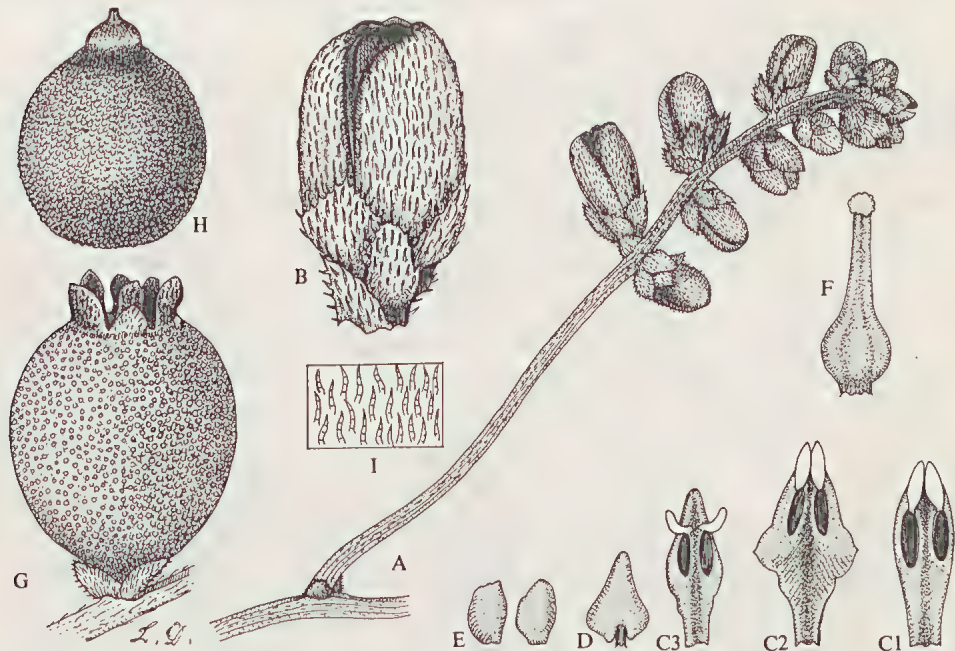


Fig. 20. *Cassytha rufa*. A, stem and inflorescence with flowers. B, flower, showing bracts and hairs. C, stamens, front view, showing open loculi and upright flaps: C1, second whorl; C2, first whorl, showing laterally expanded filament; C3, third whorl. D, staminode, centripetal view. E, glands. F, ovary. G, fruit, showing verticillate basal bracts and rotate perianth. H, stone. I, hairs, enlarged, on petals.

Specimens examined

QUEENSLAND: *Allen* 496 (CANB). *Brass* 19103 (CANB, G); 19632 (CANB). *Chisholm* s.n. (Herb. Lon(K). *Clemens* s.n. (BRI 177503, G, K, NY). *Flecker* s.n. (BRI 177829). *Jones* 1878 (CANB). *White* 8935 (BRI, NY).

12. *Cassytha melantha* R. Br., *Prod. Fl. Nov. Holl.* 404 (1810); Sprengel, *Syst. Veg.* 2: 271 (1825); Nees, *Syst. Laur.* 647 (1836); Hook. f., *Fl. Tasm.* 1(4): 317 (1857); Meisner in DC., *Prod. Syst. Nat. Regni Veg.* 15: 254 (1864); Benth., *Fl. Austral.* 5: 311 (1870); Spicer, *Handb. Pl. Tasmania* 130 (1878); F. Muell., *Fragm.* 5: 167 (1866); Tate, *Trans. R. Soc. S. Aust.* 6: 95 & 149 (1883); F. Muell., *Key Syst. Vict. Plant.* 125 (1887-1888); F. Muell., *Sec. Syst. Census Austral. Plant.* 7 (1889); F. Muell., *Native Pl. Victoria* 24 (1889); Tate, *Handb. Fl. Extratrop. South Australia* 205 (1890); Moore, *Handb. Fl. New South Wales* 19 (1893); Bailey, *Queensland Fl.* 4: 1314 (1901); Rodway, *Tasmanian Fl.* 165 (1903); Diels & Pritzel, *Bot. Jahrb. Syst.* 35: 201 (1905); Dixon, *Pl. New South Wales* 33 (1906); Maiden & Betche, *Census New South Wales Pl.* 82 (1916); Ewart, *Handb. Forest Trees Victoria* 124 (1925); Ewart, *Fl. Victoria* 522 (1931); Gardner, *Enum. Pl. Austral. Occ.* 44 (1931); J.M. Black, *Fl. South Australia* ed. 2(2): 365 (1948); Blackall & Grieve, *How to Know Western Australia Wildflowers* 1: 168 (1954); Curtis, *Stud. Fl. Tasmania* 3: 597 (1967); Burbidge & Gray, *Fl. A.C.T.* 176 (1970); Beadle, Evans & Carolin, *Fl. Sydney Reg.* 152 (1972); Beadle, *Stud. Fl. North Eastern New South Wales* 2: 120 (1972); Willis, *Handb. Pl. Victoria* 2: 159 (1973).

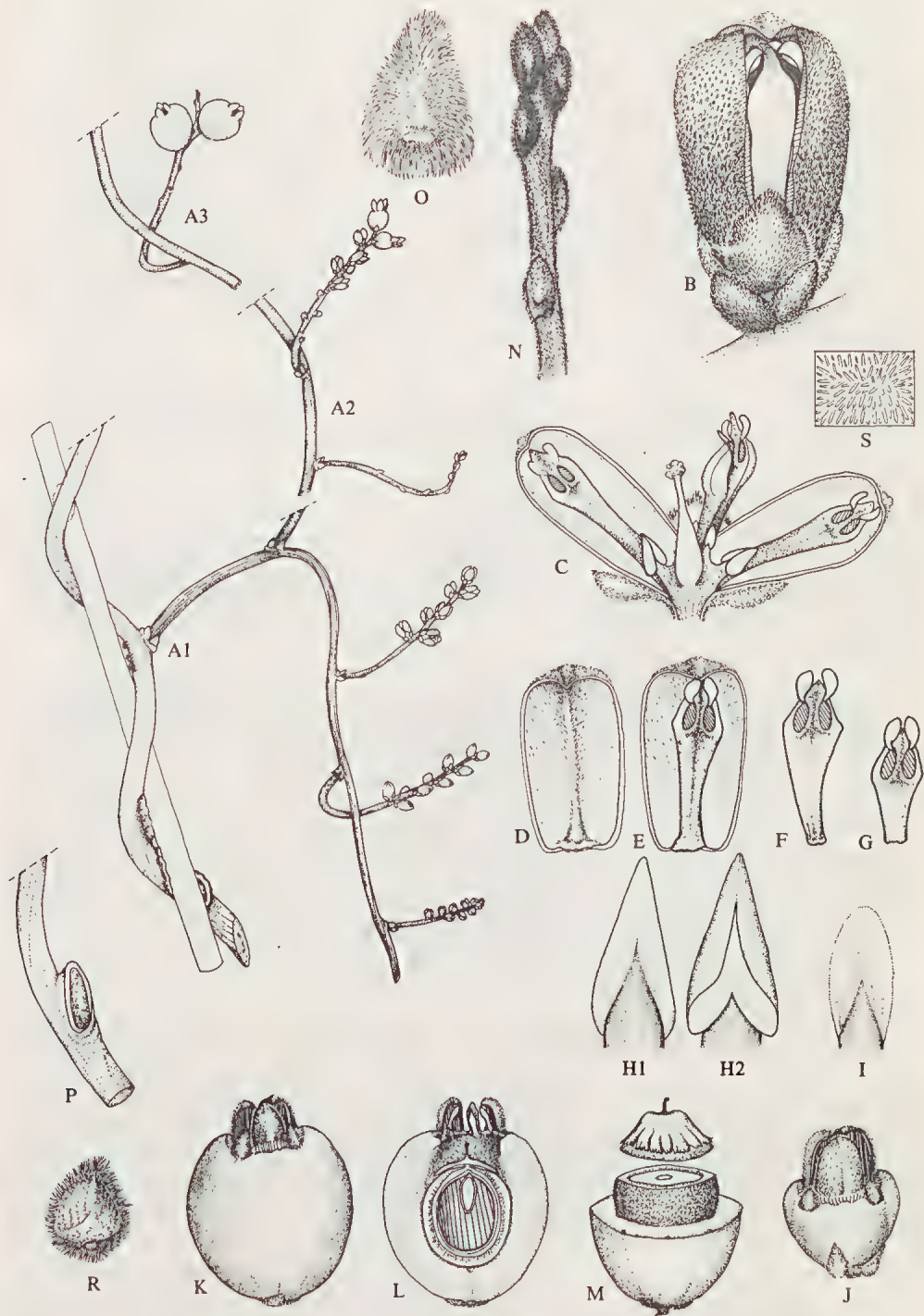
Type: R. Brown (*Bennett* 3020), Port Jackson (Australia), 3.ix.1803 (BM, lecto.; K, isolecto.). (lectotypified here).

Vernacular Names

"*Large Dodder-laurel*", Ewart, *Fl. Victoria* (1931); "*Devil's Twine*", Burbidge & Gray, *Fl. A.C.T.* (1970); "*Coarse Dodder-laurel*", Willis, *Handb. Pl. Victoria* (1973); "*Snotty gobbler*" (South Australia).

Stem (0.9-) 1.3-2 (-4) mm thick, glabrescent, green to reddish-green. *Haustoria* elliptic, 2-5 mm long. Young shoots pubescent. *Leaves* triangular, basifixed to ovate, peltate, c. 1 x 0.8 mm, red-pubescent, hairs 0.1-0.2 mm long and centrifugally spreading, appressed so the leaf appears ciliate or fimbriate; often centrally placed yellow gland furnished with transverse furrow. Leaves and bracts turning black on drying. *Inflorescence* a single or rarely clustered more or less elevated spike; peduncles (8-) 20-30 (-95) x (0.8-) 1 (-1.5) mm, usually darker than stem, covered with white and red, short retrorse hairs, (1-) 6-9 (-13) flowered; flowers commonly in upper half of peduncle, frequently one or two lower remote from the rest. Supporting bract triangular, basifixed, 1-2 x 0.8-1.2 mm, pubescent, hairs white and tinted red and black, centrifugally appressed; bracteoles similar but smaller. *Flowers* ovate, (2-) 2.4-2.6 (-3) x (1.3-) 1.5-1.7 (-2) mm subsessile to sessile; pedicel inconspicuous, 0.2-0.3 (-1) mm long, hidden by floral bracts. Floral bracts verticillate; bract triangular, c. 1 x 1-1.4 mm, hairs short, reddish, appressed, spreading centrifugally; bracteoles deltoid-ovate, 0.5-0.6 x 0.7-0.9 mm, indumentum similar. Receptacular tube short, densely pubescent with reddish and black

Fig. 21. *Cassytha melantha*. A, habit: A1, stem and inflorescence with flowers; A2, stem with inflorescence, lower with buds, upper with young fruits; A3, stem and inflorescence with mature fruits. B, flower, showing bracts and peduncle. C, flower with receptacle cut open to show stamens, staminodes, gland, ovary and receptacular tube. D, petal, from inside, showing dorsal rib. E, petal, from inside, with dorsi-basally attached stamen of the second whorl. F, stamen of the first whorl, front view, showing open loculi and upright flap. G, stamen, of the third whorl, front view. H, staminode, showing short stalk: H1, centrifugal view; H2, centripetal view. I, gland, enlarged to the same scale as the staminode. J, young fruit, showing verticillate bracts and perianth. K, mature fruit, showing bracts and perianth with slightly open orifice. L, longitudinally sectioned fruit, showing stone and orifice, surmounted by stamens and petals. M, fruit cut open to show the stone in horizontal section. N, young shoot with scale leaves. O, scale leaf, showing radiate pubescence and glabrous central gland. P, haustorium. R, sepal, from beneath. S, hairs on central portion of petal.



hairs. *Sepals* deltoid, (1-) 1.2 (-1.3) x (0.9-) 1 (-1.2) mm, pubescent, hairs white and black on centre of sepal, reddish on margin. *Petals* ovate, acute, (1.9-) 2.3-2.5 (-2.7) x (1.3-) 1.4-1.6 (-1.9) mm, pubescent on both sides with short, thick, retrorse, appressed black hairs, outside basally a reddish indumentum is frequent. Nine *stamens* fertile, flap elliptical, c. 0.4 x c. 0.2 mm; stamens of the first whorl narrow-rhomboid, (1.7-) 1.8-1.9 (-2.2) x (0.7-) 0.8 (-0.9) mm, filament often laterally expanded, sometimes with small lateral protuberances; stamens of the second whorl oblanceolate, (1.5-) 1.9-2 (-2) x (0.4-) 0.5 (-0.6) mm, cells obcordate, wider than filament, filaments terminally produced into a small, flat inflexed beak; stamens of the third whorl similar to those of second, 1-2 x c. 0.4 mm. *Staminodia* obcordate, c. 0.7 x c. 0.4 mm, shortly stalked, white, turning brown; gland ovate somewhat angular to hexagonal, c. 0.5 x 0.2-0.3 mm, white, turning brown, *ovary* fusiform, c. 2 x 0.5 mm, glabrous, stigma c. 0.3 mm across. Receptacular tube pubescent inside. *Fruit* globular, 10-15 mm across, glabrescent, light-green to cream-white, usually drying black, (7-) 8-9 (-10) mm across; petals dark-brown, leathery, rotate; orifice open. *Stone* globular, c. 0.5 mm across, black. (Fig. 21.)

Distribution (Map 12)

Endemic to Australia occurring in all States except Northern Territory and Queensland, from 30° latitude southwards, penetrating from the coast to far inland.

Flowering

Flowers from June to October, rare in November and December. Fruiting from September to December, but some specimens with fruits were found through January and February, only a few in March. Buds on inflorescences appear from February to May. The flowering period throughout Australia is most regular in this species and is confined to the coolest months of the year.

Morphology

This is the most robust representative in the genus, usually growing on shrubs and trees. One specimen (J.Z. Weber 620, Hindmarsh Waterfall, South Australia, 24.ix.1967 [AD]) has fasciculate and panicle inflorescences to 140 mm long, where the single branch is to 70 mm long and has 15 remote flowers. Another specimen with long peduncles, 95 mm long, (*A.B. Cashmore s.n.*, Kangaroo Island, South Australia, 19.vii.1933 [ADW 1096]) has 10 remote flowers along the peduncle, similar to *C. pubescens* (see morphology discussion) and *C. aurea* var. *candida*, but differs in the stouter and usually darker stem (more pronounced when dry), the dark-red to black appearance of the inflorescence and also retrorse short black hairs on the petals. Glabrescent fruits are most frequent but they are occasionally more hairy (*W.H. Harvey* 5, Colony of Victoria, September/December 1854 [TCD]).

Specimens examined

WESTERN AUSTRALIA: *Barrett* 8 (PERTH). *Batt s.n.* (MEL 497, 58732). *Briggs* 233a, 298 (NSW). *Brooke s.n.* (MEL 58643, 58674, 58676, 58726, 58744). *Brooker* 3711 (PERTH). *Carrick* 3956 (AD, PERTH). *Cawthorne* 76 (PERTH). *Chinnock* 3288 (AD, CANB, K, PERTH); 3349 (AD, CANB, PERTH); 4135 (AD). *Cronin s.n.* (MEL 58714). *Demarz* 1045 (KINGS PARK). *Diels & Pritzel* 587 (PERTH). *Donner* 4583 (AD, P, PR). *Drummond* 69 (MEL). *Fitzgerald s.n.* (NSW 135080). *Forrest s.n.* (MEL 58492). *George* 8050 (PERTH). *Helms s.n.* (AD 97424454, MEL 58447-8, NSW). *Hugg* 6948 (PERTH). *Knox* 65x054 (PERTH). *Kenneally* 1300 (PERTH). *Haegi* 1011 (AD, HBG, M); 1191 (AD, NY). *Oldfield s.n.* (MEL 58483). *Orchard* 1258 (AD, PERTH); 1382 (AD, CANB, PERTH); 1490 (AD, PERTH). *Parsons* 192 (AD). *Paust* 803, 870 (PERTH). *Royce* 3649, 9073, 9211 (PERTH). *Stone* 854 (CANB, PERTH). *Sullivan* 25 (MEL). *Turner s.n.* (MEL 58667). *Weber* 5221 (AD, NY); 5229 (AD, BM). *Whibley* 4704 (AD, CANB); 5257 (AD, BRI). *Wilson* 1646, 2898 (AD, PERTH).

NEW SOUTH WALES: *Beadle s.n.* (SYD). *Betche s.n.* (NSW 135103). *Blundell s.n.* (NSW 135081). *Boorman s.n.* (NSW 135082, 135096, 135099, 135101-2). *Burbidge s.n.* (NSW 135083). *Burken s.n.* (NSW 135095). *Cabbage* 1364 (NSW, SYD); 2797 (NSW); 3238 (NSW, SYD). *Campbell s.n.* (NSW 106148, 135097). *Carolyn* 822 (SYD). *Carrick* 3198 (AD, K, NSW). *Constable s.n.* (NSW 4621). *Coveny* 2548 (NSW); *s.n.* (NSW 127719).

Crisp 1620 (AD, BISH, CANB). Cunningham 3, 222, 552 (NSW). Donner 4725 (AD, M, TCD). Dwyer s.n. (NSW 135098). Ford s.n. (NSW). Hamilton s.n. (NSW 135092-3). Hartley 13562 (CANB). Holding s.n. (MEL 58488-90, 58740). Ingram 3471, 4931, 8264, 8658, 10470 (NSW); s.n. (NSW). Johnson 1225 (NSW); s.n. (NSW 135094). Lauterer s.n. (MEL 58724); s.n. (BRI 032956). Logan s.n. (NSW 135100). MacGillivray 922 (NSW). McBarron 7307 (NSW). Mein s.n. (MEL 58487). Moore 2692 (BRI, CANB); 3120 (CANB). Nash s.n. (AD 97015456). Story 6805 (CANB, NSW). Taylor 4 (NSW). Whaithe 2309, 3369 (NSW).

VICTORIA: Anderson s.n. (MEL 58465). Aston 31, 120, 403, 438, 992, 1062 (MEL). Beauglehole 6976, 16954, 21082, 22452 (BEAUGLEHOLE); 29191 (AD, BEAUGLEHOLE). Bird s.n. (MEL 58725). Brown s.n. (MEL 62376). Canning 3013 (AD). Carrick 3081 (AD, MEL); 3335 (AD). Cullimore 2 (MEL); 181 (BRI, MEL). Davies 35 (NSW). Dellar s.n. (MEL 58700). Dillon s.n. (MEL 62373). Funk s.n. (MEL 58662). Hart s.n. (MEL 58473-4). Jephcott s.n. (MEL 58494). Matthews s.n. (MEL 58491). Merrall s.n. (MEL 58730). Moore 3626 (CANB). Morris 1534 (NSW). Mueller s.n. (MEL 58449-51, 58453, 58455, 58458, 58460, 58477). Orchard 2449 (AD, CHR); 2700 (AD, HAL, LY). Pitcher s.n. (MEL 58462). Reader 23 (MEL); s.n. (MEL 58452, 58459, 58681). Sullivan 3 (MEL 58620). Tracey 53 (MEL 58627). Wallace 53 (MEL). Walter s.n. (NSW 135078). Watts 455 (NSW). Weber 3718 (AD); 5235 (AD, M). Williamson s.n. (NSW 135077). Wilson 11 (MEL).

TASMANIA: Barker 934 (AD, HO). Burns s.n. (HO 7468). Chinnock 2234 (AD, NT). Cleland s.n. (AD 96841143, 97226170). Curtis s.n. (HO 7472-3). Davies s.n. (NSW 135079). Hannaford s.n. (HO 7469). Hooker s.n. (MEL 58445 & 58486). Long 565 (CANB, HO). Rodway s.n. (HO 7470). Story s.n. (MEL 58481, 58734).

SOUTH AUSTRALIA: Alcock 51B, 2419, 2923 (AD); 4789 (AD, SYD); 5300, 5533 (AD). Anon. (Herb. J.M. Black) s.n. (AD 97423313, 97423331, 97424478-9, 97424481-2). Barker 1749 (AD, PRC); 1758 (AD, BISH); 3635 (AD, PRC). Bates 279 (AD); s.n. (AD 97615023, 97626081, 97722506). Beak 98 (AD). Blaylock 362, 388, 2305 (AD). Bowen 245 (AD). Cambage 248 (NSW). Canning 2206 (CANB). Carrick 3559 (AD, M, W); 3765 (AD). Carter s.n. (ADW 24618). Cashmore s.n. (ADW 1096). Cleland s.n. (AD 966090646-7, 96601720). Chinnock 1345 (AD, BRI, OXF); 2410 (AD); 2664 (AD, CHR); 2775 (AD, B, HAL). Chorney 711 (AD, NBG, SI). Copley 515 (AD, FI, OXF); 866 (AD); 955 (AD, H, TI); 4648 (AD, NY). Cooper s.n. (AD 96229398, 96144048). Crisp 363 (AD). Czorny 97 (AD, B); 966 (AD, UPS, WU); 804 (AD). Donner 816 (AD, MT, JB); 997 (AD); 4753 (AD, PE). Eardley s.n. (ADW 1095, 3958). Eichler 14164 (AD, G, PRE, NY); 16205 (AD); 19134 (AD, BM, K, M, NY); 19713 (AD, BRI); 19271 (AD, G, L). Everist 5757 (AD). Fieldhouse 49 (AD). Forde 463 (CANB). Gardner s.n. (AD 96323103). Gill 143 (MEL); s.n. (NSW 135069). Grivel s.n. (AD 96929617). Haegi 359, 434, 439, 419 (AD); 568 (AD, K, M, NY, P); 590 (AD, BRI, CANB). Haylock 70 (AD). F. Hill 604 (BM). R. Hill s.n. (AD 96322048). Hilton 1607 (ADW). Hornsby s.n. (AD 98003242). Hunt 707, 2392 (AD). Hussey s.n. (MEL 62374). Ising s.n. (AD 96221179, 96506103, 96603497, 97012074, 97127050). E. Jackson 510 (AD, UC, Z); 760 (AD); 2331 (AD, CANB, NSW). G. Jackson 434, 459 (AD); 510 (AD, CANB); 512 (AD); 519 (AD, OXF, P); 554 (AD, MEL, PERTH); 564, 583, 584 (AD). Kraehenbuehl 1093, 1379, 1529 (AD); 1552 (AD, M); 2488 (AD, HBG); 2499 (AD); 2795 (AD, BISH); 2796 (AD, BA); 3040 (AD). Kuchel 24, 3313 (AD). Litchfield s.n. (ADW 8868). Lothian 5414 (AD, CANB). Mack 1 (AD). Nash s.n. (AD 9738073). Orchard 2021 (AD, HBG, TCD); 2196 (AD, CHR). Painter & Heath 7 (AD). Pearce s.n. (ADW 29662). Phillips 138 (NSW). Richard s.n. (AD 97424453, MEL 58604, 58680). Roach 50 (AD, OXF). Rogers s.n. (NSW 135072). Rohrlach 383 (AD). Saddler s.n. (ADW 32047). Sharrad 710, 993 (AD). Shaw s.n. (AD 97244290, 9724308). Smith 3 (MEL). Specht 2027, 2231, 2429, 2683 (AD); s.n. (AD 97331293). Spooner 812, 911, 1429, 1520, 1927 (AD). Stear s.n. (NSW). Symon 823A (AD, ADW, CANB); 952 (ADW); 1497, 2928 (ADW, PERTH); 3633, 4956 (ADW); 6259 (ADW, DAV); 7595 (ADW); 8234 (AD, ADW, CANB). Tepper s.n. (AD 966100776, 97424452, MEL 58593, 58495). Turner s.n. (AD 96222113, 97603357, 97612337). Velleman 032 (AD). Weber 620 (AD); 1729 (AD, H, L); 1823 (AD); 1951 (A, AD, B); 1955 (A, AD, B, G); 1957 (AD, M, HBG, NY); 1958 (AD, BRI, CANB, NT); 1972 (AD, NT); 3225 (AD, CANB, PERTH); 3693, 3705 (AD); 3712 (AD, TRN); 3722 (AD, BRI); 3766 (AD); 3772 (AD, HAL, LY); 3798 (AD, HO); 3817 (A, AD, B); 3870 (AD, NT); 4415 (AD); 4438, 5231 (AD, CANB); 5234 (AD, FRI); 5238 (AD). Wheeler 418 (A, AD); 490 (partly) (AD); 823 (AD, COLO); 910, 1105 (AD). Whibley 1639, 1929 (AD); 1991 (AD, AK); 3660 (AD, TCD); 5813 (AD). Wilkinson s.n. (ADW 18353). Wilson 56 (AD, UC); 993 (AD); 1430 (AD, MEL, OSH); 1462 (AD, HBG, G, LY); 1582 (AD, CANB, PERTH); 1722 (AD, NT). Woolmer 109 (AD).

13. *Cassytha pomiformis* Nees in Lehm., Pl. Preiss. 620 (1845); Walp., Ann. 1: 579 (1848); Meisn. in DC., Prod. 15: 253 (1864); Benth., Fl. Austral. 5: 313 (1870); F. Muell., Second Census Austral. Pl. 7 (1889); Diels & Pritzel in Engl., Bot. Jahrb. 35: 202 (1905); Gardner, Enum. Pl. Austral. Occ. 44 (1931); Webb, J. Austral. Agr. Sci. 19: 146 (1953).

Type: *L. Preiss 1625*, Prope oppidulum Fremantle, Dec. 1838 (MEL 58520, holo.; MEL 59521, NY, iso.). (nominated here.)

C. ceratopoda Meisn. in DC., Prod. 15: 257 (1864); Benth., Fl. Austral. 5: 313 (1870).

Type: *J. Drummond 150*, (? "In colonia Swan River", Western Australia) (K, (?) MEL 58517, syn.). *J. Drummond 151* (? "In colonia Swan River", Western Australia) (K, NY, (?) MEL 58518, syn.). Both

Drummond collection in K & NY have the name of the collector (Drummond) and number only, those in MEL only his initials undoubtedly written by F. Mueller and matching the types in K & NY. No other Drummond collection of this taxon was located in MEL by the present author. (These two collections were erroneously cited by Ewart & Davies (Fl. Northern Territory 113 (1917) for "Northern Australia".)

C. multiflora Nees in Lehm., Pl. Preiss. 621 (1845) (vide Bentham [1870] as syn. of *C. pomiformis* var. *pubiflora*).

Type citation: "King Georges Sound. All. Cunningham in herb. Schauer. Herb. Preiss. No. 2629". Not seen.

C. subcapitata Meisn. in DC., Prod. 15: 253 (1864); Benth., Fl. Austral. 5: 313 (1870).

Type: J. Drummond 63, Swan River (1845) (MEL 58552, lecto; K, NY, iso.).

C. pomiformis var. *pubiflora* Benth., Fl. Austral. 5: 313 (1870).

Type: Based on *C. multiflora* Nees in Lehm., Pl. Preiss. 621 (1845) - Preiss 2629; not seen.

Stem (0.2-) 0.5-0.7 (-1.3) mm thick, yellow-green or grey-green to dark-green (dried), covered with bristly white hairs or glabrescent. Young shoots pubescent. **Leaves** ovate, peltate, 1-1.5 x 0.5-0.8 mm, with or without dorsal gland, retrorse pubescent, ciliate basally, cream-green, turning brown. **Haustoria** irregular in shape, sometimes 1-4 mm long with ring of hairs at the attachment. **Inflorescence** single, sometimes paired fasciculate, panicle of racemes or umbel, to 45 mm long, pubescent. Supporting bract triangular, c. 0.7 mm long and wide, pubescent, brown (dried); bracteoles similar, smaller or larger, attached at the base of peduncle or carried variously on it. Peduncles short or long, 2.5-30 x 0.6-0.8 mm in young stage, often becoming clavate with age, 1-1.8 mm



Fig. 22. *Cassytha pomiformis*. A, stem and inflorescence with flowers. B, clavate peduncle with young fruit. C, flower, showing pedicel with basal bracteoles. D, stamens, front view, showing open loculi and upright flaps: D1, second whorl, showing cilia on the filament; D2, first whorl, showing laterally expanded filament with cilia; D3, third whorl. E, staminode, centripetal view, showing white apical gland. F, glands, centripetal view, showing white apical glands. G, ovary and lower style, showing hairs. H, fruit, showing basal bracts and perianth with closed orifice.

thick. *Flower* ovate, 2-2.5 x 1.3-1.6 mm, outside yellow, inside white. Pedicels 0.4-1.5 x 0.2-0.8 mm, distinctly white pubescent. Floral bracts verticillate at base of pedicel or in two planes. Floral bract ovate, peltate, c. 1.4 x 0.7 mm or triangular and basifixed, c. 0.7 x 0.5 mm, both pubescent, brown; bracteoles triangular, c. 0.5 x 0.3 mm, pubescent, brown. Receptacular tube short, white-pubescent, suddenly contracted into the pedicel. *Sepals* triangular-ovate, c. 0.6 x 0.6 mm, yellow-brown, pubescent outside, turning brown. *Petals* ovate, subacute, 1.5-1.9 x 0.8-1 mm, antrorse pubescent on both sides, yellowish, turning dark brown. Nine *stamens* fertile, white, turning brown; stamens of the first whorl obovate, 1-1.2 x c. 0.7 mm, with filament under the cells more or less expanded laterally, occasionally ciliate; stamens of the second whorl oblanceolate, obtuse, 1-1.2 x 0.3-0.5 mm, cells obcordate, wider than filament which is sometimes ciliate; stamens of the third whorl oblanceolate, acute, c. 1 x c. 0.5 mm, cells wider than filament and bulging over staminodes and glands. Staminodes narrow-pyramidal, c. 0.6 x 0.3 mm, white, turning brown, with white apex; glands ovoid, dorsi-ventrally flattened, c. 0.5 x 0.3 mm, white, turning brown, crested white. *Ovary* fusiform, c. 1.5 x 0.5 mm, glabrous or sprinkled with hairs. Receptacular tube pubescent inside. *Fruit* fusiform-globose, c. 10 x 6 mm, grey pubescent, yellow-green, turning green-black, globose portion carried on distinct darker pedicel and sometimes supported by floral bracteoles. *Stone* globular, c. 5 mm across, dark brown. (Fig. 22.)

Distribution (Map 13)

Endemic to south-western Western Australia, from Geraldton southwards to King George Sound, eastwards to Esperance and also inland.

Flowering

Flowering specimens have been collected from July to January, specimens in fruit from August to December. Specimens with flower and fruits are frequent.

Notes

Specimens with paired inflorescences show diversity in the age of peduncles, where the shorter and thicker carried fruits or were barren, the longer and less clavate carried flowers.

Specimens examined

WESTERN AUSTRALIA: *Backhouse s.n.* (K). *Beaglehole* 11863, 49292 (BEAGLEHOLE). *Carne s.n.* (PERTH). *Chinnock* 3166 (AD, K, PERTH); 3278 (AD, M, MEL); 3696 (AD, CANB). *Davies* 504 (AD). *Demarz* D1798 (KINGS PARK). *Diels & Pritzel* 233 (PERTH). *Donner* 4582 (AD, PERTH). *Drummond suppl.* 65 (MEL, K, NY). *Easton s.n.* (MEL 58706). *Eichler* 20103 (AD, NSW, PERTH); 20364 (AD, PERTH); 20402 (AD). *Forrest s.n.* (MEL 58603). *George s.n.* (PERTH). *Haegi* 1213 (AD, HO, TCD). *Harvey* 6 (K, NY, TCD). *Keighery* 1200 (KINGS PARK). *McFarland* 1259 (AD, BRI, PERTH). *Morris s.n.* (MEL 58519). *Morrison s.n.* (BM, BRI, K). *Mueller s.n.* (MEL, 52338, 58515-6, 58689, 58691-2, 58753). *Orchard* 4233 (AD). *Preiss* 28 (K); 1622 (HBG). *Pritzel* 144 (AD, BM, G, K, M, NSW). *Royce* 8105 (AD, PERTH). *Sewell s.n.* (MEL 58634, 58705). *Stoward* 387 (K). *Weber* 5033 (AD, CANB, K, PERTH); 5034 (AD, BRI, HO, K, NSW, NY, W, Z); 5037 (AD, G); 5143 (AD, OXF, P). *Whibley* 3740 (AD, BM); 4760 (AD); 4974 (AD, PERTH).

14. *Cassytha racemosa* Nees in Lehm., Pl. Preiss. 1: 621 (1845); Walp., Ann. 1: 579 (1848); Meisn. in DC. Prod. 15: 257 (1864); Benth., Fl. Aust. 5: 312 (1870); Bailey, Synops. Queensl. Pl. 427 (1883); F. Muell., Second Census Aust. Pl. 7 (1889); Bailey, Cat. Queensl. P. 39 (1890); Bailey, Queensl. Fl. 4: 1315 (1901); Diels & Pritzel in Engl., Bot. Jahrb. 35: 202 (1905); Bailey, Compreh. Catal. Queensl. Pl. 439, f. 425 (1913); Gardner, Enum. Pl. Austral. Occid. 44 (1931); Blackall & Grieve, How to Know W.A. plants 169 (1954).

Type: L. Preiss 1623, Prope oppidulum Fremantle, Perth, Western Australia (MEL 58594, lecto.; K, MEL 58597, iso.). (lectotypified here.)

C. subcapitata Meisn., in DC., Prod. 15: 253 (1864) partly; Benth., Fl. Austral. 5: 212 & 213 (1870).

Type: *J. Drummond* 203, In colonia Swan River, Western Australia (K, iso.).

C. racemosa var. *genuina* Hochreutiner, Candollea 2: 365 (1925) nom. illeg., based on specimen—*B.P.G. Hochreutiner* 2972, Claremont près de Perth, 16.ii.1905 (G).

Stem (0.3-) 0.6-.08 (-2) mm thick, glabrescent to pubescent, light yellow-green or brownish to dark-green. Young shoots pubescent, *leaves* 1.5-2.5 x 0.5-0.8 mm, often with a central gland, glabrescent or more or less ciliate, narrow-ovate and peltate or triangular-ovate and basifixed (eastern specimens). *Haustoria* elliptical, c. 1 mm across, often several in row, long when not attaching to host. *Inflorescence* single, paired or fasciculate, sometimes paniculate, final racemes short or long, peduncles 3-30 x 0.5-1 mm, glabrescent to pubescent, (1-) 4-8 (-10) flowered. Supporting bract ovate and peltate, or triangular and basifixed, 1-3 x c. 1 mm, brown, pubescent to glabrescent, ciliate; bracteoles angular-ovate to ovate, 0.5-2 x 0.3-1 mm, attached basally, pubescent to glabrescent, ciliate. *Flowers* in a loose raceme, or in a head, pedicellate, ovoid, 1-2 x 0.9-1.5 mm, white to greenish-yellow, pubescent. Pedicel 1-2 (-10) x 0.3-0.8 mm, pubescent or glabrescent, (in f. *racemosa* at fruiting swells and integrates as an obconical base to the widened receptacular tube). Floral bracts in two planes, bract at base of pedicel ovate and peltate, or triangular and basifixed, 0.5-1.2 x 0.3-0.5 mm, pubescent to glabrescent, ciliate; bracteoles smaller, remote, distally peltate to basifixed, acute, 0.5-0.7 x c. 0.5 mm, pubescent to glabrescent, ciliate, on top of the pedicel subtending the flower, on fruits inserted on the obconical receptacular tube. *Sepals* triangular-ovate to round, 0.5-0.7 mm, pubescent to glabrescent, ciliate. *Petals* ovate, bluntly acute, 1-1.8 x 0.8-1.5 mm, pubescent to glabrescent outside, with appressed white hairs inside, in fruit brown to black and leathery, incurved to rotate. Fertile *stamens* six, light yellow or white; stamens of the first whorl spatulate, obtuse, c. 1-1.5 x 0.6-0.7 mm, cells obcordate, expanded tip often as wide as the cells, filament more or less expanded laterally but not exceeding the cells; 3 stamens of the second whorl (opposite the petals), reduced to staminodes, filiform c. 1 x 0.3 mm or often adhering to the petal throughout its length, appearing only as a bulging, glabrous mid-rib; stamens of the third whorl narrow-obovate, c. 1.2 x c. 0.5 mm, cells obcordate, more or less bulging, tip often inflated. Staminodes conical, c. 0.5 x c. 0.35 mm, commonly white, turning brown, occasionally with white apex; glands ovoid, c. 0.5 x 0.3 mm, mostly white, occasionally with white tip. *Ovary* fusiform, 1-1.5 x c. 0.5 mm, pubescent all over or only in a transverse median ring. Receptacular tube pubescent inside. *Fruit* globose to pyriform, 7-11 x 5-8 mm, smooth obconical base carrying globose portion which is smooth or furnished with six bulging vertical lobes, pubescent to glabrescent. Stone ovoid, c. 4 x c. 3.5 mm, black, rough. (Figs 23-25.)

Distribution (Maps 14 & 15)

Endemic to Australia.

Flowering

Flowers all year round.

Notes

Bentham's (1870) delimitation into varieties was applied to the extreme pubescent forms; the present writer found great variation in this respect and was unable to segregate on characters of indumentum but rather on different forms of leaves, bracts and fruits.

The present author cannot segregate Western Australian specimens without fruits into forms and these are therefore mapped and listed separately.

Specimens examined—in flowers only

WESTERN AUSTRALIA: *Alexander* s.n. (PERTH). *Andrews* 725 (BM); s.n. (PERTH). *Aplin* 1242, 1376 (PERTH). *Ashby* 5165 (AD, CANB, MEL, PERTH). *Batt* s.n. (MEL 58669). *Bennett* s.n. (PERTH). *Brooker* 1727 (PERTH). *Butler* s.n. (PERTH). *Carrey* s.n. (MEL 58593). *Diels & Pritzel* 35 (PERTH). *Drummond* 133

(K, MEL); 229 (MEL); s.n. (K, MEL 58590). Eichler 20081 (AD). Fairal 2206 (PERTH). Forrest s.n. (MEL 58628). Gardner 5006 (PERTH); s.n. (PERTH). George 2105, 6382, 7181 (PERTH). Hamilton s.n. (NSW 135120). Harvey 2 (BM, K, TCD); 3 (K, NY, TCD); s.n. (BM, TCD). Hey 26 (BM). Jackson s.n. (NSW 135108). James 184 (PERTH). Keighery 705, 1256, 1546, 1570 (KINGS PARK). Kenneally 72/16 (PERTH); 2442 (AD, PERTH). Kissane 15 (PERTH). Koch 2112 (NSW, PERTH). Maiden s.n. (NSW 135124). Morrison 307 (NSW); 8435 (BM, K, PERTH); (9421; 308) (NY, PERTH); (10323; 306) (G, K); s.n. (BM, BRI 158281, K, PERTH). Mueller s.n. (MEL 58583, 58758). Muir s.n. (MEL 58736). Preiss 16 (K); s.n. (G). Oldfield s.n. (MEL 58585-6, 58690). Paust 10 (PERTH). Pritzel 48 (NSW, PR). Royce 107, 4239, 7768, 8097, 8301, 8269, 8796, 9800 (PERTH). Salasoo 4207 (NSW); Scrymgeour 184 (PERTH). Steffanoni s.n. (ADW 17235). Stokes s.n. (PERTH). Wilson 4178. Wilson 8083 (AD, PERTH). Wittwer s.n. (KINGS PARK).

Key to Forms

1. Leaves and bracts triangular, basifixed (eastern) 14c. f. *muelleri*
 Leaves and bracts ovate, peltate (western) 2
2. Fruits lobed 14a. f. *racemosa*
 Fruits smooth 14b. f. *pilosa*

14a. *Cassytha racemosa* forma *racemosa*

Leaves and bracts ovate, peltate. Fruit globose to pyriform, 6-8 x 6-7 mm, glabrescent; base of fruit obconical, short and wide, including expanded pedicel between bract and bracteoles; globose portion divided into 6 vertical, thick, bulging lobes, each topped by a

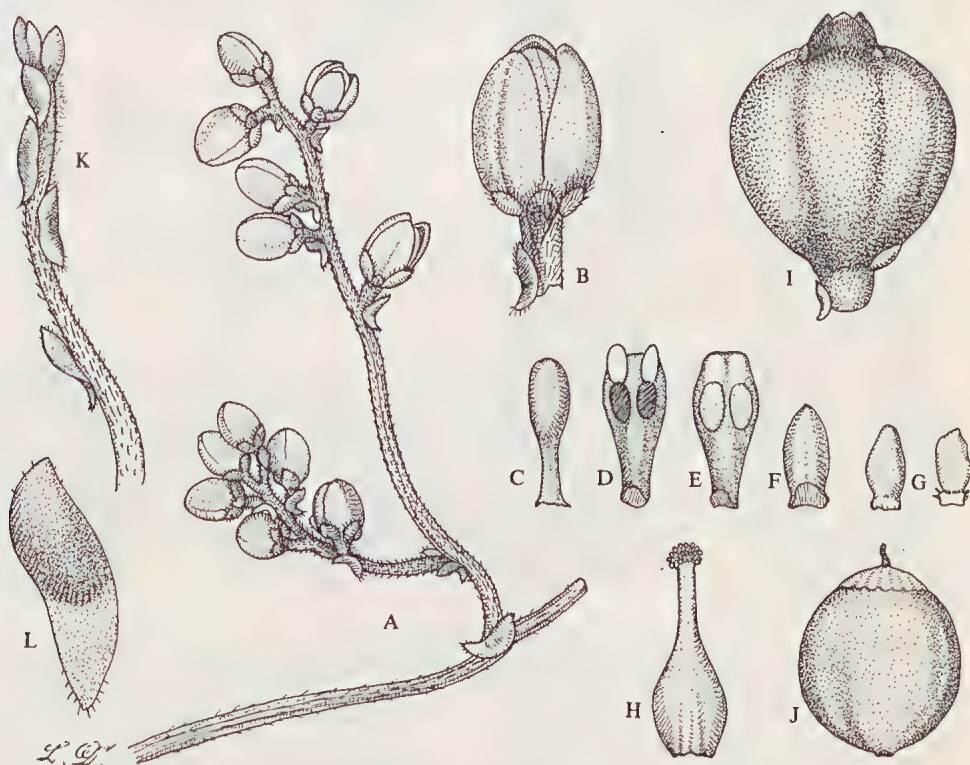


Fig. 23. *Cassytha racemosa* f. *racemosa*. A, stem and inflorescence with flowers in a panicle raceme. B, flower, showing pedicel with basal bract and remote higher bracteoles subtending the flower. C, sterile stamen of the second whorl. D, stamen of the first whorl, front view, showing open loculi and upright flaps. E, stamen of the third whorl, front view, showing loculi. F, staminode. G, glands. H, ovary. I, lobed fruit, showing pedicel with basal bract and remote higher bracteole subtending the fruit, the perianth enclosing the orifice. J, stone. K, young shoot with peltate scale leaves. L, scale leaf, showing upper fleshy anterior portion.

perianth segment; orifice covered by the horizontal incurved perianth and androecium. Floral bracteoles in flower attached to the pedicel; in fruit clasping and embedded in basal portion. (Fig. 23.)

Distribution (Map 14)

Endemic to Western Australia in the South West Division, spreading from Shark Bay southwards to Pemberton, eastwards approaching the Stirling Range, mostly confined to flats near the sea.

Similarities

The ovate peltate leaves show similarities with *f. pilosa*, but the lobed, quite globular and smaller fruits of this form differ from the smooth more pyriform fruits of *f. pilosa* and *f. muelleri*. The pedicel of *f. racemosa* is integrated as a widened (ob) conical part of the fruit: in the other two forms it is quite distinct, cylindrical and narrow.

Specimens examined

WESTERN AUSTRALIA: *Barker* 2238 (AD, MEL, PERTH); 2297 (AD, BRI, CANB). *Beauglehole* 12365 (BEAUGLEHOLE). *Burbidge* 7988 (CANB). *Chinnoek* 3187 (AD, HO, K, NSW). *Drummond* 133 (BM, NY, TCD); 229 (BM, G, TCD); *s.n.* (MEL 58592). *Eichler* 15763 (AD). *Fitzgerald s.n.* (NSW 135104). *Helms s.n.* (PERTH). *Jackson* 3148 (AD, HBG, M). *Koch* 2578 (MEL). *Meebold* 477 (M). *Morrison* 1301 (K); 9422 (BRI, K, PERTH); *s.n.* (BM, BRI 158218, 158235, K). *Mueller s.n.* (MEL 58755, 58756). *Orchard* 4241 (AD, AK). *Paust* 1401 (PERTH). *Pritzel* 48 (AD, BM, G, K, M). *Royce* 8236 (PERTH). *Salasoo* 4271 (NSW). *Taylor per Shugg* 13 (PERTH). *Weber* 5105 (AD, CANB, G, PERTH). *Wilson* 6266 (AD, PERTH).

14b. *Cassythia racemosa* forma *pilosa* (Benth.) J.Z. Weber, stat. et comb. nov.

C. racemosa var. *pilosa* Benth., Fl. Austral. 5: 312 (1870).

Type: *A. Oldfield*, King George Sound, Western Australia (MEL 58581, lecto.; MEL 58580, iso.). (lectotypified here).

C. umbellata Meisn. in DC., Prod. 15: 258 (1864); Benth., Fl. Austral. 5: 312 (1870), partly.

Type: *W.H. Harvey* 5, near Cape Riche, Western Australia, March 1854 (K, lecto.) (lectotypified here). Two other collections, labelled *Harvey* 5, have been seen: Between Perth and King George Sound, (W. Australia) Apr., July, 1854 (TCD) (= *C. racemosa* f. *pilosa*); and Colony of Victoria, Sept./Dec., 1854 (TCD) (= *C. melantha*).

Leaves and bracts ovate, peltate. *Fruit* variously pyriform to globose, smooth, 9-11 x 3.5-7 mm, pubescent to glabrescent, greenish to honey-yellow, turning dark-green to black. Perianth and androecium vertical to slightly rotate. Southern fruits (south of 29° lat.) are more pyriform, c. 10 x c. 4 mm with conspicuous, sometimes with a reddish glandular ring apically, gradually narrowing towards the quite distinct pedicel where the floral bracteoles clasp the (ob) conical base of the receptacular tube. Northern fruits are more globose, c. 9 x c. 7 mm, lacking a glandular ring, the receptacular tube not gradually but quite suddenly narrowed into a distinct pedicel. (Fig. 24.).

Distribution (Map 14)

Endemic to Western Australia along the western and southern coast from North West Cape, southwards from Shark Bay through the South West Division, entering the Eucla Division to Israelite Bay.

Similarities

This form shows similarities with *f. racemosa* in the ovate and peltate leaves but differs in the smooth more pyriform fruits, similar to those of *f. muelleri*.

Notes

C. umbellata Meisn., which Bentham (1870, p. 312) regarded as "rather half-monstrous state of *C. racemosa* var. *pilosa*", was apparently based on *W.H. Harvey* 5. One of the duplicates of this collection, housed at K, is the type of *C. umbellata* and is

labelled in ink; the other, housed at TCD, is annotated in pencil and was collected "Between Perth and King George Sound, April/July, 1854". The latter is advanced in fruit, but not fully developed, having the globose portion on a rather long, narrow stalk. This occurrence is not rare in younger fruits.

Specimens examined

WESTERN AUSTRALIA: *Aplin* 2099 (PERTH). *Blackall* 4386 (PERTH). *Brooke* s.n. (MEL 58642, 58719). *Chinnock* 3299 (AD, LY, OXF). *Canning* s.n. (CBG 038579, NSW). *Donner* 2724 (AD, PERTH); 2989 (AD, CANB, PERTH). *Drummond* 229 (K, MEL). *Eichler* 19899 (AD, CANB, CHR, NY, PERTH, UPS); 20079 (AD, CANB, K, PERTH). *Fitzgerald* s.n. (NSW). *George* 6554 (PERTH). *Goodall* 1876 (PERTH). *Jackson* 1270 (AD, PERTH, TCD); 1313 (AD, HO, PERTH); 1407 (AD, NY, PERTH). *Keighery* 826, 1418 (KINGS PARK). *Koch* 2534 (NSW). *Maiden* s.n. (NSW 135125). *Meebold* 7155, 10073 (M). *Morrison* 7410 (K). *Mueller* s.n. (MEL 58484, 58589, 58638-9, NSW 135105). *Nash* s.n. (AD 97050163). *Orchard* 1682 (AD, CHR, HO, PERTH). *Royce* 108, 2821, 8655, 9904, 9924 (PERTH); s.n. (PERTH). *Sewel* s.n. (MEL 58647). *Weber* 5108 (AD, PERTH); 5152 (AD, K, M). *Wilson* 2968 (AD, CANB, PERTH); 5400 (AD, PERTH).

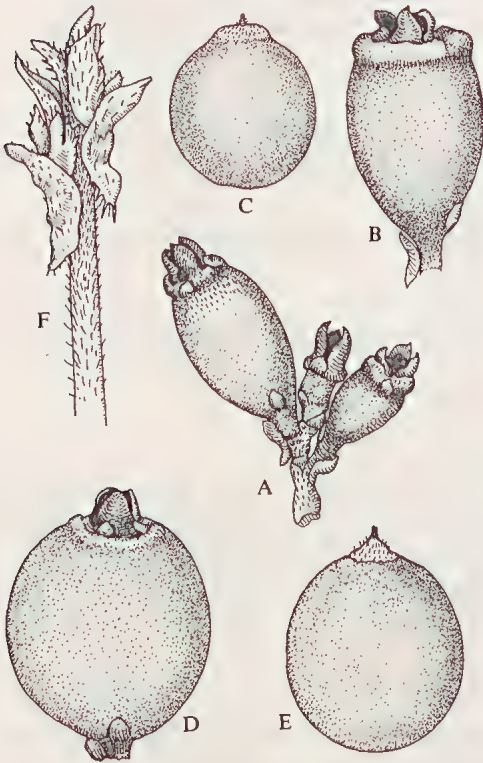


Fig. 24. *Cassythia racemosa* f. *pilosa*. A, inflorescence, showing fruits in different stages of maturity. B, mature smooth pyriform fruit, showing pedicel with basal bract and remote higher bracteole subtending fruit; apical glandular ring encircling the perianth, with open orifice. C, stone or pyriform fruit (B). D, mature smooth globose fruit, showing pedicel with basal bract and remote higher bracteole subtending the globose fruit; apical faint glandular ring encircling the perianth with a slightly open orifice. E, stone of globose fruit (D). F, young shoot with peltate scale leaves.

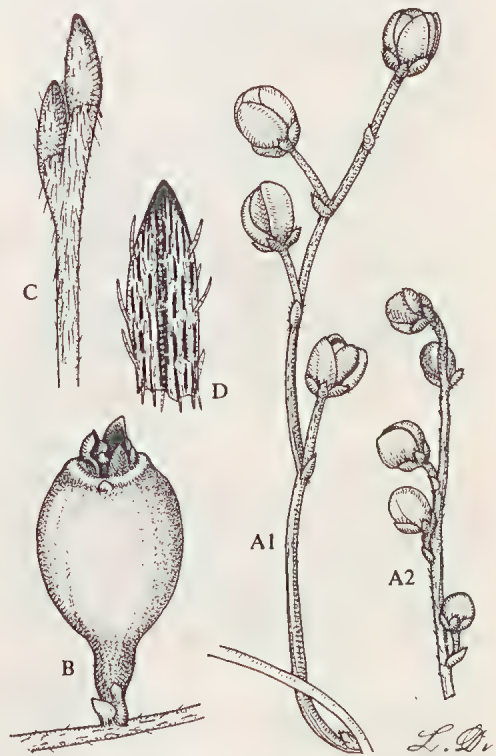


Fig. 25. *Cassythia racemosa* f. *muelleri*. A, inflorescence with flowers in a raceme, showing pedicellate flowers: A1, with stem basally; A2, showing hairs on the peduncle. B, pyriform fruit, showing cylindrical pedicel with basal bract and remote higher bracteole supporting the obconical narrow base; apical glandular ring encircling the perianth, with open orifice. C, young shoot, showing triangular scale leaves attached basally. D, scale leaf, enlarged, showing hairs.

14c. *Cassytha racemosa* forma *muelleri* (Meisn.) J.Z. Weber, stat et comb. nov.

C. muelleri Meisn. in DC., Prod. 15: 257 (1864); Benth., Fl. Austral. 5: 312 (1870); Bailey, Queensl. Fl. 4: 1315 (1901); Domin, Bibl. Bot. Band 22, Heft 89/2: 680 (1925).

Type: *F. Mueller*, Moreton Island, Queensland, Australia, August 1855 (MEL 58598, lecto.; K—2 sheets, NY, iso.) (lectotypified here.)

C. racemosa non Nees, sensu Benth., Fl. Austral. 5: 312 (1870), p.p. as to syn. *C. muelleri* Meisn.

Leaves and bracts triangular and basifixed, c. 1.5 x c. 0.8 mm, glabrescent, ciliate, dark brown (in sicco). Fruits smooth, pyriform, 8-9 x 4-5 mm, glabrescent, dried dark-green to brown, glandular ring well developed on top, basal obconical portion of receptacular tube gradually narrowing towards pedicel; pedicel is distinct between bract and bracteoles, hardly enlarged; perianth and androecium vertical, orifice open. (Fig. 25.)

Distribution (Map 15)

Occurs in the south-east of Queensland from Gympie south, around Brisbane and westwards towards Crows Nest; in New South Wales it is limited to Rocky Creek, between Cooldale and Grafton.

Similarities

This form shows similarities with *f. pilosa* in the smooth and pyriform fruits but differs from both other forms in the triangular basifixed leaves and bracts.

Notes

Stems of Queensland specimens are thinner than those from New South Wales which are as thick as the two western forms.

Specimens examined

QUEENSLAND: *Everist s.n.* (BRI 024805). *Smith 323, 14820* (BRI). *White s.n.* (BRI 177839, NSW 135106). *Anon s.n.* Marochy R. (BRI 177836).

NEW SOUTH WALES: *Coveny 1857* (NSW); *4981* (AD, NSW).

Nomen Dubium

Cassytha coronata Nees in Lehm., Pl. Preiss. 1: 620 (1845); Walp., Ann. 1(4): 679 (1849); Meisn. in DC., Prod. 15: 254 (1864); Benth., Fl. Aust. 5: 309 (1870); Diels & Pritzel in Engl., Bot. Jahrb. 35: 202 (1905); Gardner, Enum. Plant. Australe Occ. 44 (1931).

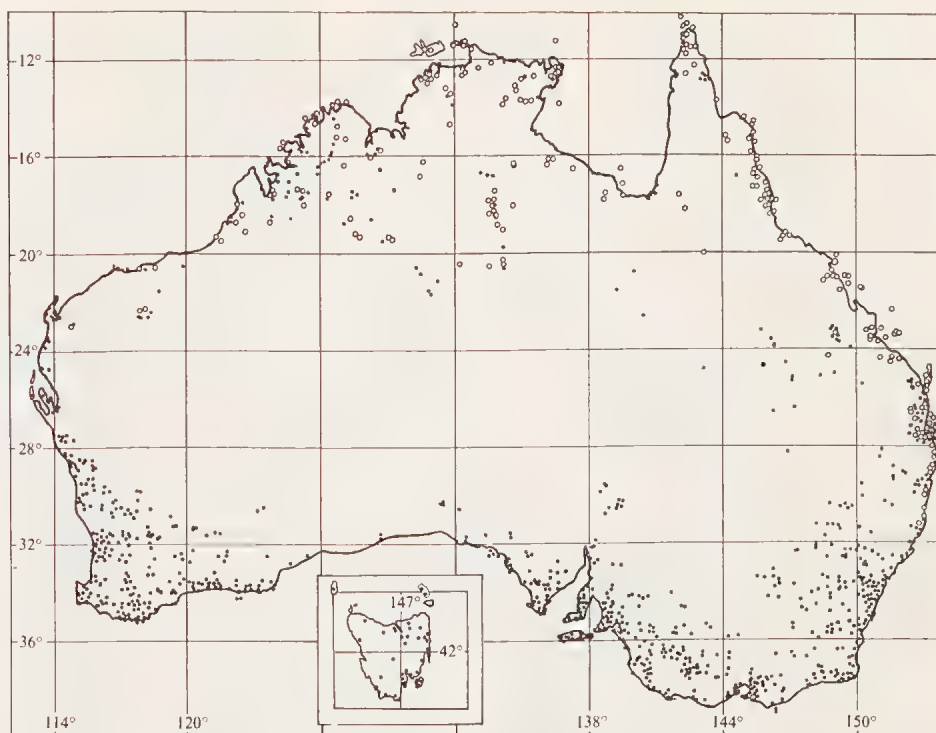
I have not seen any specimen which would comply with Nees' description in being a dioecious *Cassytha*, nor has the specimen cited by the author, *L. Preiss 1627*, from Western Australia, been seen.

Acknowledgements

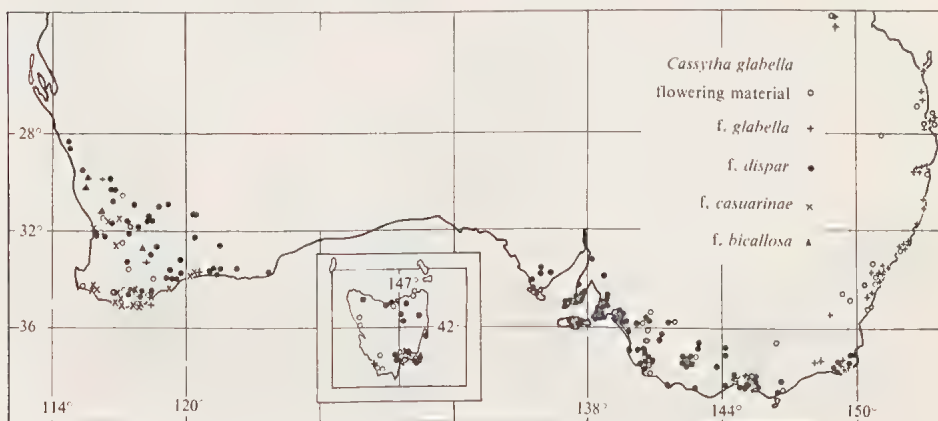
I would like to express my gratitude to many people who have assisted me in this project.

Particularly I would like to thank my supervisors, Dr D.C. Christophel and Dr J.P. Jessop for their comments on the draft of this manuscript and for help in detailed problems in this difficult genus. I am grateful to Dr H.J. Eichler, who suggested the project and enthusiastically forwarded some literature; to Mr L. Dutkiewitz for drawing the illustrations; to Miss B.A. Welling for typing the manuscript; to Mr A.C. Beaglehole for collecting specimens; and to Dr H. Tölken and the late Mr J. Carrick for assisting me with Latin diagnoses.

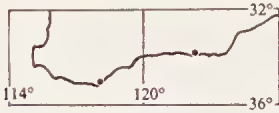
Thanks are also due to the Directors/Curators of the following institutions for the loan of Herbarium specimens: A, ADW, B, BM, BRI, CANB, FU, G, HAL, HBG, HO, JCT, K, Kings Park Perth, LY, M, MEL, NBG, NSW, NT, OXF, P, PERTH, PR, PRC, PRE, SYD, TCD.



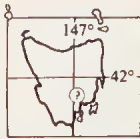
Map 1. Distribution of *Cassytha filiformis* (circles) and of all other species (spots).



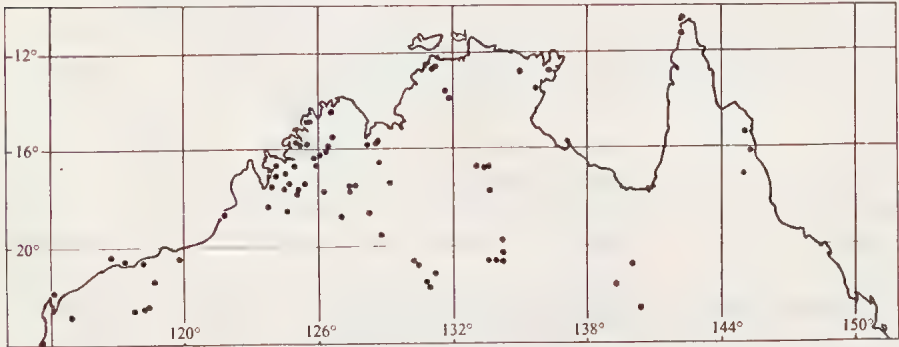
Map 2. Distribution of *Cassytha glabella*.



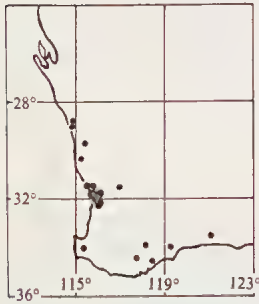
Map 3. Distribution of *Cassytha micrantha*.



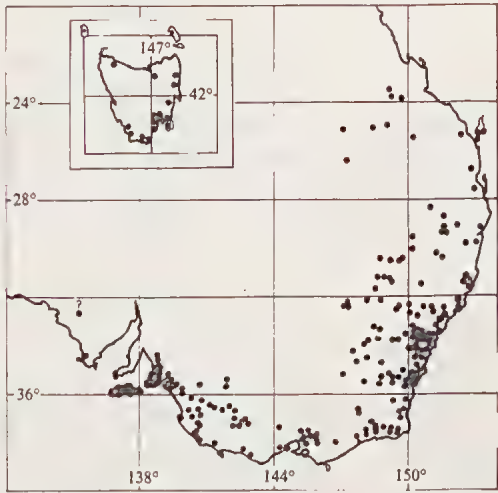
Map 4. Distribution of *Cassytha pedicellosa*.



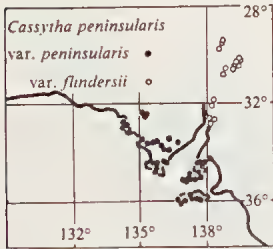
Map 5. Distribution of *Cassytha capillaris*.



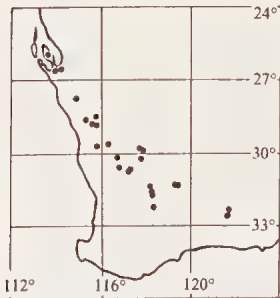
Map 6. Distribution of *Cassytha flava*.



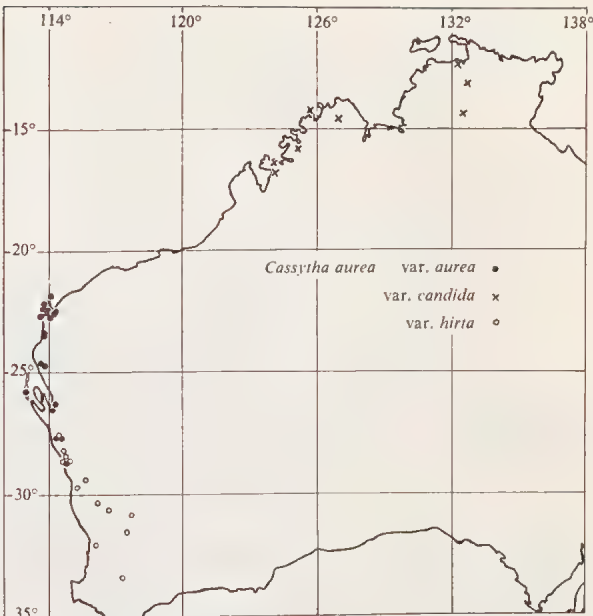
Map 7. Distribution of *Cassytha pubescens*.



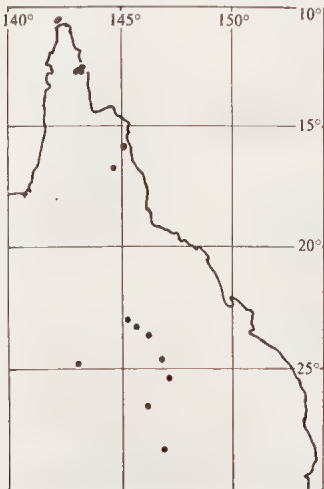
Map 8. Distribution of *Cassytha peninsularis* var. *peninsularis* (spots) and var. *flindersii* (circles).



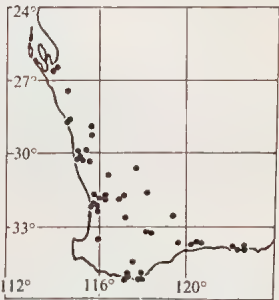
Map 9. Distribution of *Cassytha nodiflora*.



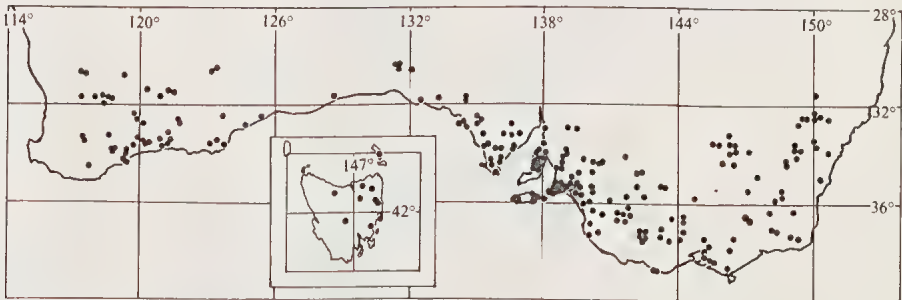
Map 10. Distribution of *Cassytha aurea*.



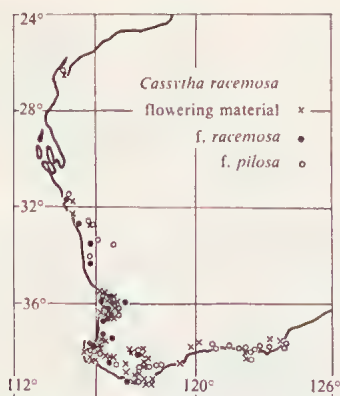
Map 11. Distribution of *Cassytha rufa*.



Map 13. Distribution of *Cassytha pomiformis*.



Map 12. Distribution of *Cassytha melantha*.



Map 14. Distribution of *Cassytha racemosa* formae *racemosa* and *pilosa* and flowering material (not indentifiable to forma).



Map 15. Distribution of *Cassytha racemosa* forma *muelleri*.

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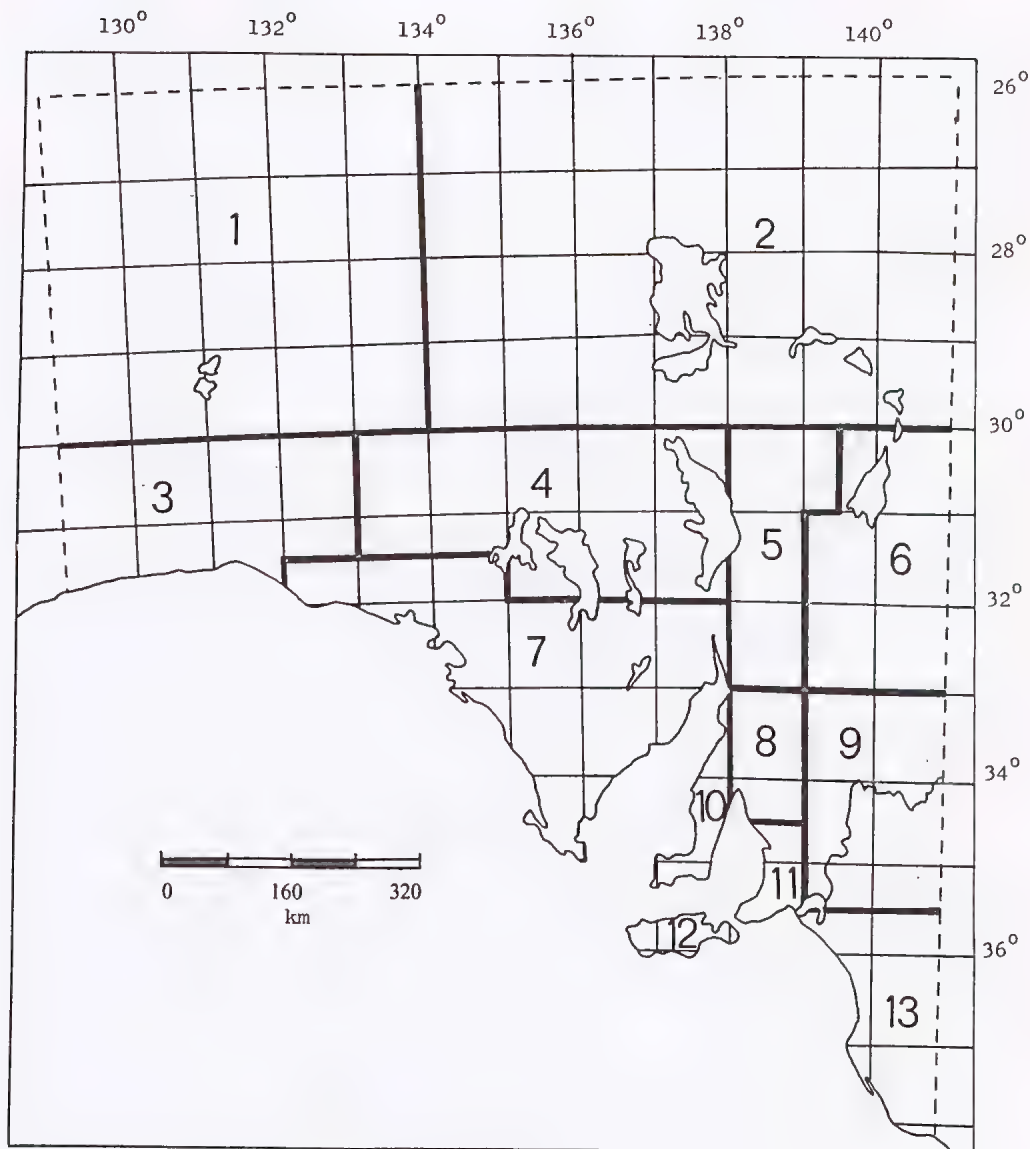
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- | | |
|---------------------------|---------------------|
| 1. North-western | 8. Northern Lofty |
| 2. Lake Eyre Basin | 9. Murray |
| 3. Nullarbor | 10. Yorke Peninsula |
| 4. Gairdner-Torrens Basin | 11. Southern Lofty |
| 5. Flinders Ranges | 12. Kangaroo Island |
| 6. Eastern | 13. South-eastern |
| 7. Eyre Peninsula | |



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